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LICHEN GENUS *PARMELIA* IN INDIAI—Subgenera *Parmelia* and *Amphigymnia*

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ABSTRACT

The paper primarily meant for Indian botanists interested in the study of Indian lichens deals with 102 species of the genus *Parmelia*, subgenera *Parmelia* and *Amphigymnia*. The taxa of this genus are widely distributed in India. The study is largely based on the actual examination of the specimens lodged in the different herbaria as indicated. Keys for the identification of the species in the two subgenera (subg. *Parmelia* 67 spp., subg. *Amphigymnia* 35 spp.) have been formulated to enable the Indian workers to identify the species easily. The detailed description of the species and compilation of some information brings-up the total information about the Indian taxa. Several taxa are new reports for the country though they have not been referred to that way. There are two new combinations—*Parmelia awasthii* (Hale & Patw.) Awas., and *P. dodapetta* (Hale & Patw.) Awas. made, and five new species—*Parmelia erhiziosa* Awas., *Parmelia halei* Awas., *P. microlobulata* Awas., *P. pindarensis* Awas. & S. Singh, and *P. pseudomarmariza* Awas. are described. Photographs of the majority of the species have been provided to confirm the identifications with the help of the figures and also to get an idea of the range of variation found in the subgenera. The species under each subgenus have been treated in alphabetical order.

KEY-WORDS

Thallophyta, Lichens, Morphotaxonomy, *Parmelia* in India

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INTRODUCTION

The genus *Parmelia* (Ach.) DNot. as circumscribed by ZAHLBRUCKNER (1926) comprised over seven hundred species (ZAHLBRUCKNER, 1930, 1932, 1940) distributed under

the four subgenera *Hypogymnia* Nyl., *Menegazzia* (Vain.) Zahlbr., *Euparmelia* Nyl., and *Omphalodium* (Mey & Flot.) Nyl. Distinctive morphological and anatomical peculiarities and differences in the subgenera *Hypogymnia*, *Menegazzia* and *Omphalodium* were accepted since long by the lichenologists and they were recognised as regular genera in subsequent years. However, since there was no monographic study on the whole genus on world-wide basis, the taxa of *Parmelia* continued to be treated according to ZAHLBRUCKNER's concept. The exhaustive studies by HALE and KUROKAWA (1964) accepted the subgenus 'Euparmelia' to comprise the genus *Parmelia*, which was then subdivided into the four subgenera: *Parmelia*, *Amphigymnia* (Vain.) Dodge, *Xanthoparmelia* (Vain.) Hale, and *Melanoparmelia* (Hue). These subgenera had been treated as sections within 'Euparmelia' by ZAHLBRUCKNER (1926). One of the sections of 'Euparmelia'—*Everniaeformes* Zahlbr.—was, however, not included in any of the subgenera accepted by HALE and KUROKAWA (1964).

Continuation of the exhaustive studies on the Parmelias by HALE, particularly his observations on the cortex by S.E.M. (HALE, 1973), prompted him to a drastic re-grouping of the taxa so far included within *Parmelia* according to the concept of HALE and KUROKAWA. As a result, HALE (1974a, 1974b, 1974c, 1974d) carved out seven additional genera by acceptance of the old or creation of the new. These genera are *Parmotrema* Mass. [=subgenus *Amphigymnia* (Vain.) Dodge]; *Hypotrachyna* (Vain.) Hale [=subg. *Parmelia*, sect. *Hypotrachyna* Vain.]; *Bulbothrix* Hale [=subg. *Parmelia*, sect. *Imbricaria*, subsect. *Bicornutae* (Lynge) Hale & Kurok.]; *Parmelina* Hale [=subg. *Parmelia*, sect. *Imbricaria* (Schreb.) Fr., subsect. *Imbricaria*]; *Relicina* (Hale & Kurok.) Hale [=subg. *Parmelia*, sect. *Imbricaria*, subsect. *Bicornutae*, ser. *Relicinae* Hale & Kurok.]; *Xanthoparmelia* (Vain.) Hale [=subg. *Xanthoparmelia* Vain.]; *Pseudoparmelia* [=subg. *Parmelia*, sect. *Cyclocheila* (Vain.) Räs.]. The genus *Parmelia* s. str. would, thus, comprise the taxa included in the subg. *Parmelia*, sect. *Parmelia*, and both the subsections treated therein by HALE and KUROKAWA (1964). The subgenus *Melanoparmelia* is expected to be treated as a genus at another centre of lichenological studies in U.S.A. In short, the large genus *Parmelia* of over six hundred species has shrunk to about 1/10 of its size in the number of species by these recent treatments. Majority of the species have been distributed in the 8 genera mentioned above.

I do not wish to entertain the merits or demerits of the delimitations proposed by HALE, but am treating the Indian Parmelias under the genus *Parmelia* as understood earlier by HALE and KUROKAWA (1964) with the addition of the section *Everniaeformes* Zahlbr. of subg. *Euparmelia* of the concept of ZAHLBRUCKNER (1926). This preference neither reflects my conservatism for lumping the taxa nor opposes the modern progressive developments. It only reflects a belief that, as far as possible, the identification of the macro-lichen genera should be possible on the basis of the gross morphology—by naked eye or by hand-lens even while collecting in the field.

Over ninety species had been enumerated by AWASTHI (1965) under the genus *Parmelia* from Indian subcontinent. Out of them, about a dozen taxa belong to the genera *Hypogymnia*, *Menegazzia* and *Cetrelia*. Since this enumeration includes the taxa reported in recent or distant past, and much before the work of HALE (1965), and HALE and KUROKAWA (1964) were available, the identity of them is not necessarily correct according to the present concept of the species. It is more likely that several of the previous determinations are incorrect, and thus cannot be relied upon for the assessment of the total taxa of *Parmelia* from India. The following study is, therefore, based on the investigations of the specimens examined afresh and preserved in the herbaria indicated. Few reports made after 1965 have been included, and these are those made by KUROKAWA

(1966, 1967) for the taxa of which I was not able to get the specimens, or that they have been reported from some particular area. The identifications have been made primarily based on the representative specimens identified by HALE and few by KUROKAWA, as well as on the basis of the literature. Specimens have been investigated in respect of their morphological and anatomical details, colour reactions common in lichenology and micro-crystallography by ASAHINA's method. We have not been able to investigate the lichen substances by T.L.C. (Thin Layer Chromatography), but, except in few cases, the morphology and crystallography have been sufficient to delimit and correlate our determinations with those of HALE.

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Parmelia (Ach.) DNot.

Ach. *Meth. Lich.* 153. 1803; DNot. *Giorn. Bot. Ital.* 11 (2): 189, 1847.

Thallus foliose, dorsiventral, glaucous white, grey, yellow grey, grey brown, olivaceous brown to dark brown, paraplectenchymatously corticated on both sides, algal cells Protococcus type, medulla compact (not hollow); lower side generally rhizinate, rhizinae simple or branched. Apothecia laminal, lecanorine, hypothecium hyaline to yellowish, asci usually 8 spored, spores colourless, simple, paraphyses septate, simple or branched; pycnidia laminal.

HALE and KUROKAWA (1964) and HALE (1965, 1975 a, 1975 b) have discussed in great detail the external morphology of the thallus and the chemistry of the chemical substances found in them and indicated their significance in the taxonomy of the genus. There is no intention to repeat them here. The following observations are intended to help in the determination of the taxa by the Indian workers.

The colour of the thallus has played an important part in the delimitation of two subgenera in particular. However, the presence of usnic acid characteristic of the *Xanthoparmelias* is also found in several species—both in subgenera *Parmelia* and *Amphigymnia*, where other characters have been considered to be more important. Similarly the type of rhizinae and their distribution has been very important for subgeneric or sectional delimitations, but in all groups, types characteristics of the other groups are found. Dichotomously branched rhizinae are present in taxa of *Parmelia* s. str., and are thus not

found only in sect. *Hypotrachyna*. Extension of rhizinae upto the margin occurs in few species of subgenus *Amphigymnia* which are characterized by their absence in the marginal region. The presence of cilia in *Amphigymnia*, though is a good character to separate the taxa, cilia become difficult to be discerned in some species of subgenus *Parmelia*, or the marginal rhizinae may be confused as cilia.

The thallus shows much variation in its size—from few centimeters to over 25 cm in diameter, and the lobes are also variable considerably, some of which may be as broad as 20 mm. The upper surface of the thallus is either uniform, smooth, or shows fine white maculations which, in some cases, are quite prominent (*P. nilgherrensis*) or are faint to difficult to discern. These maculations represent the areas where the algal cells are absent below the cortex. What factors make this algal distribution dispersed does not seem to have been investigated. In other cases (*P. saxatilis* group) the maculae tend to be effigurate, prominent at the subapical region of the lobes, but changing to pseudocyphellae in the older part of the thallus. Only few species have true pseudocyphellae from the very beginning of the thallus development and are restricted to the upper side only. The thallus in some cases has a tendency to get cracked (*P. reticulata* group) soon after, while in several taxa the lobes get cracked when older and consequently does not seem to have much taxonomic significance in the latter taxa. In the majority of the taxa, the thallus is generally adnate to substratum either throughout the lower side or near the middle part, the marginal region being free. Only in few taxa (*P. cirrhata* group) the thallus is distinctly different, but even in them the young thalli are often seen to be adnate to the substratum. The branching and the nature of the lobes may be helpful in some groups. The rotund to subrotund, subrotund to sublinear, truncate type of lobes are often found to delimit the sections of the subgenera. The marginal cilia are generally long in subg. *Amphigymnia* but are uniformly short in subg. *Parmelia*, wherever they occur. The basally thickened cilia are referred to as bulbate cilia by HALE, and are quite characteristic for delimitation, but in some cases they are very small and need careful examination.

The rhizinae or rhizinal papillae are found distributed throughout the lower side of the thallus in the subgenera *Parmelia*, *Xanthoparmelia* and *Melanoparmelia*. They may then be sparse or densely distributed, may be simple, squarrosely branched or dichotomously branched. Rarely, however, a narrow marginal zone may be erhizinate, but other characters may indicate the group to which some of these taxa may belong. The restriction of rhizinae, mostly simple, in the central part of the thallus characterizes *Amphigymnia*, though in some cases they are uniformly distributed and even found up to the margin on lower side. The subgenus *Parmelia* sect. *Hypotrachyna* has been characterized by the presence of dichotomously branched rhizinae, but in some taxa majority of the rhizinae are simple, the dichotomously branched ones are few and scattered between the simple ones.

Isidia occur in several species and are commonly used to distinguish the taxa in the keys. The size and nature are often variable in the different taxa, but sometimes the isidia tend to be coralloid branched in apparently more humid and warm conditions than in drier areas. Rarely (*P. vexans*) they may assume extra-ordinarily elongated lobulate shape, which can be mistaken to belong to a different taxon. However, intermediate conditions dispel this belief. In the majority of cases they are laminal, but in few cases are marginal as well. In some cases they also tend to be ciliate apically to simulate the ciliate margin of the lobes.

The soralia, like the isidia, are good key characters for separating the groups of taxa. They may be laminal, submarginal or marginal. The extent, size, and developmental stages vary greatly, but are usually constant in the different taxa. The typically marginal

and laminal character needs to be given greater importance in delimiting the taxa. It is generally observed that the marginal soralia possess farinose soredia while the laminal types have both farinose and granular soredia. The pustulate-sorediate condition found in some taxa is also characteristic, but often the pustules may produce so much of soredia that unless the young pustulate condition is available for examination the pustulate-sorediate condition may not be distinct.

Barring few taxa, majority of the *Parmelias* are known in fertile condition, though not all of them produce apothecia in Indian specimens. The apothecia are typically laminal, sessile, adnate, and substipitate to distinctly pedicellate. The disc is often perforated in the taxa of subg. *Amphigymnia*, though this perforated condition is lacking in subg. *Parmelia* even when the apothecia are very large. The disc is generally red brown to dark brown, smooth, the amphithecium either smooth or rugulose, and then often maculate. The spores are constantly simple, oval to oval-ellipsoid or even ovoid, variable from about 5 μm to about 35 μm in length usually with thin but sometimes with a thick (about 3 μm) epispore wall. Only rarely the characters of spores are useful for segregation of the taxa.

The chemical reactions on the upper cortex and medulla by the well-known K, C, KC, and P reagents are very important and useful as key characters. We have used the crystallographic method of ASAHINA for the verification of the lichen acids and found it useful in the majority of taxa. The identification by T.L.C. of the lichen substances has not been carried out.

The genus *Parmelia* is subdivided into the following subgenera on the basis of the colour of thallus, the nature of lobes and the nature and distribution of rhizinae.

- 1a—Thallus generally mineral grey to grey or dark grey (rarely yellow grey)
- 2a—Rhizinae with rhizinal papillae present throughout the lower side up to the margin, lobes subrotund, sublinear to linear truncate.....subg. *Parmelia*
- 2b—Rhizinae sparse, usually restricted in groups in central part of lower side, a wide marginal zone on lower side naked, erhizinate, lobes broad, rotund to subrotund.....subg. *Amphigymnia*
- 1b—Thallus colour other-wise
- 3a—Thallus pale yellow to yellow, rhizinae simple, distributed up to the margin on lower side, usnic acid present, chiefly saxicolous species.....subg. *Xanthoparmelia*
- 3b—Thallus brown to dark brown or olivaceous brown, rhizinae present throughout the lower side up to the margin.....subg. *Melanoparmelia*

Subgenus *Parmelia*

HALE & KUROKAWA, *Contr. U. S. Nat. Herb.* 36: 121-188, 1964, cum *Parmelia* subg. *Euparmelia*, sect. *Everniaeformes* Zahlbr.

Parmelia subg. *Euparmelia*, sect. *Everniaeformes* Zahlbr. and sect. *Hypotrachyna* Zahlbr. in Engl. & Prantl, *Natural Pflanzenfam.* 1(1): 213, 1907, and 2 ed. Vol. 8: 235, 1926.

Subgenus *Parmelia* is characterized by mineral grey to grey (rarely yellow grey) thallus with subrotund, sublinear to linear truncate lobes. The lower side is rhizinate up to the margin, the marginal areas in some cases have rhizinal papillae instead of the well developed rhizinae. The rhizinae are either simple and/or squarrose branched or simple and dichotomously branched. The apothecia are sessile to adnate, to substipitate and imperforate.

HALE and KUROKAWA (1964) had subdivided the subgenus into the sections *Parmelia*, *Irregulares*, *Imbricaria*, *Cyclocheila* and *Hypotrachyna* on the basis of the nature of lobes, presence or absence of pseudocyphellae, nature of rhizinae (simple, squarrose, or dichotomously branched), presence or absence of cilia, and nature of cilia (bulbate or simple). Some of these sections and their subsections have been elevated to the rank of genus as outlined in the introduction. Since information about the sections and subsections is

available in HALE and KUOKAWA (1964) I have not divided the species treated here into the different sections, but taken them as a whole, though in the formulation of the keys it reflects to some extent a grouping corresponding to those divisions. The main departure has been the inclusion of the species of *Parmelia cirrhata* complex and disregard for the marginal cilia except at few cases. This has been done purposely because the short marginal cilia (unlike those of the Amphigymnias) are sometimes difficult to locate or are present in the axils or sinuses of the lobes where they are difficult to be distinguished from the rhizinae. Greater importance has been given to the chemical reactions and the morphological characters, as they are handy for the majority of the Indian workers who do not have the facilities to examine the chemical substances by T.L.C. Fortunately there are few cases where a T.L.C. may absolutely be necessary; even in them determination by other characters may be found useful.

KEY TO INDIAN SPECIES OF SUBG. *PARMELIA*

- 1a—Thallus pseudocyphellate
 - 2a—Thallus maculate-pseudocyphellate
 - 3a—Thallus isidiate, medulla K+red
 - 4a—Maculae effigurate, isidia on margins of pseudocyphellae.....51. *P. saxatilis*
 - 4b—Maculae densely dispersed, isidia uniformly laminal.....33. *P. meiophora*
 - 3b—Thallus lacking isidia
 - 5a—Thallus sorediate, maculae effigurate, medulla K+red.....61. *P. sulcata*
 - 5b—Thallus lacking soredia
 - 6a—Rhizinae densely squarrosely branched, spores 8—12 μ m long.....59. *P. submutata*
 - 6b—Rhizinae simple, furcate to dichotomously branched
 - 7a—Spores 11—14(20) \times 7—10 μ m, maculae minute, dense.....31. *P. marmariza*
 - 7b—Spores 18—25 μ m long
 - 8a—Maculae raised, sparse to dense, cortex not cracked.....44. *P. pseudomarmariza*
 - 8b—Maculae sparse, cortex densely cracked.....1. *P. adaugescens*
 - 2b—Thallus lacking maculae, pseudocyphellae rounded to elliptic
 - 9a—Thallus isidiate, medulla C+red.....50. *P. rudecta*
 - 9b—Thallus lacking isidia
 - 10a—Thallus sorediate
 - 11a—Thallus yellow green to yellow grey (usnic acid present).....*P. flaventior*
(see under subg. *Amphigymnia*)
 - 11b—Thallus grey (usnic acid lacking)
 - 12a—Lower side pale brown, medulla C+red, lecanoric acid present..60. *P. subrudecta*
 - 12b—Lower side black, medulla C+rose red, gyrophoric acid present....6. *P. borrevi*
 - 10b—Thallus lacking soredia, medulla K+red, apothecia concave 2mm
in diameter, spores 12—20 μ m long.....48. *P. ricasolioides*
- 1b—Thallus lacking pseudocyphellae
 - 13a—Margin of lobes with bulbate cilia
 - 14a—Thallus isidiate, medulla K+red28. *P. isidiza*
 - 14b—Thallus lacking isidia and also soredia
 - 15a—Medulla K + red
 - 16a—Lower side pale brown, spores 12—22 μ m long.....55. *P. setschwanensis*
 - 16b—Lower side jet black
 - 17a—Lobes 4—10 mm wide, spores 12—20 μ m long.....34. *P. meizospora*
 - 17b—Lobes 2—4 mm wide, spores 7—11 μ m long.....54. *P. sensibilis*
 - 15b—Medulla K—, G—, KG—, P—, bulbate cilia prominent, spores 5 \times 4 μ m....8. *P. bulbochaeta*
 - 13b—Margin of lobes lacking bulbate cilia, margin eciliate or with simple cilia
 - 18a—Thallus suberect or pendulous, dichotomously branched, lobes linear,
tapering, canaliculate on lower side, margin with long cilia
 - 19a—Thallus isidiate, rhizinae simple to dichotomously branched.....65. *P. vexans*
 - 19b—Thallus lacking isidia and soredia
 - 20a—Lower side rhizinate, rhizinae short, simple to branched.....38. *P. nepalensis*

- 20b—Lower side lacking rhizinae.....10. *P. cirrhata*
- 18b—Thallus adnate, lobes not tapering
- 21a—Rhizinae simple and/or squarrosely branched
- 22a—Thallus isidiate
- 23a—Isidia soon dorsiventral, lobulate and adnate.....35. *P. microlobulata*
- 23b—Isidia cylindrical, erect
- 24a—Medulla K+red
- 25a—Thallus dichotomously branched, linear, lobes tapering,
canaliculate, cilia long, isidia some times much elongated...65. *P. vexans*
- 25b—Thallus lobes rotund to subrotund, cilia short mostly
at axils, isidia cylindrical, simple to branched.....66. *P. wallichiana*
- 24b—Medulla K— or + yellow
- 26a—Medulla pigmented K—, upper side maculate....40. *P. perisidians*
- 26b—Medulla white
- 27a—Medulla G+red
- 28a—Upper side maculate, medulla G+red,
(lecanoric acid present).....64. *P. tiliacea*
- 28b—Upper side emaculate, medulla G+red
(gyrophoric acid present)15. *P. dissecta*
- 27b—Medulla G—
- 29a—Thallus yellow grey (usnic acid present)
- 30a—Medulla P+orange red, lobes nar-
row, divaricatic acid absent.....30. *P. malaccensis*
- 30b—Medulla P—, lobes broad, divaricatic acid
present.....17. *P. caeperata*
- 29b—Thallus grey (usnic acid absent)
- 31a—Medulla white to yellowish P+
orange, stictic acid present.....23. *P. halei*
- 31b—Medulla P—19. *P. expallida*
- 22b—Thallus lacking isidia
- 32a—Thallus pustulate-sorediate or sorediate
- 33a—Soralia marginal
- 34a—Thallus reticulately maculate and cracked,
medulla K+red.....*P. reticulata*
(see under subg. *Amphigymnia*)
- 34b—Thallus lacking maculae, medulla K—, C+red.....*P. ulophyllodes*
(see under subg. *Amphigymnia*)
- 33b—Soralia laminal
- 35a—Thallus yellow green to yellow grey (usnic acid
present), upper side pustulate-sorediate, soredia
granular..... *P. caeperata*
(see under subg. *Amphigymnia*)
- 35b—Thallus grey (usnic acid absent)
- 36a—Upper side reticulately wrinkled and ridged,
medulla P+red
- 37a—Lobes 2—5 mm wide, subrotund.....11. *P. crozalsiana*
- 37b—Lobes 1—2.5 mm wide, sublinear.....9. *P. carneopruinata*
- 36b—upper side smooth, not wrinkled
- 38a—Margin of lobes ciliate
- 39a—Medulla yellow, upper side pustulate-
sorediate.....4. *P. aurulenta*
- 39b—Medulla white, upper side indistinctly
pustulate, soralia large, or bicular, with
farinose soredia.....36. *P. mülleri*
- 38b—Margin of lobes lacking cilia
- 40a—Medulla white to yellowish, di-
varicatic acid absent.....3. *P. aptata*

- 40b—Medulla white, divaricatic acid present....62. *P. texana*
- 32b—Thallus lacking pustules and soredia
- 41a—Medulla white K+red
- 42a—Lobes rotund to subrotund, upper side densely
maculate and reticulately cracked..... *P. cetrata*
(see under subg. *Amphigymnia*)
- 42b—Lobes sublinear to linear
- 43a—Lower side rhizinate
- 44a—Margin of lobes ciliate, spores 15—22
 μ m long38. *P. nepalensis*
- 44b—Margin of lobes sparsely ciliate, spores
12—16 μ m long.....56. *P. simplicior*
- 43b—Lower side lacking rhizinae, thallus lobes
tapering, canaliculate on lower side.....10. *P. cirrhata*
- 41b—Medulla pigmented, pigment K—or+purple
- 45a—Pigmented medulla K+purple.....14. *P. denegans*
- 45b—Pigmented medulla K—
- 46a—Lobes uniformly of one type, 3—6 mm wide
- 47a—Spores 11—18 μ m long.....24. *P. homogeres*
- 47b—Spores 6—11 μ m long.....37. *P. subaurulenta*
- 46b—Lobes dimorphic, secondary lobes, 0.5—
1.5 mm wide, much imbricate, dichotomously
divided, short.....67. *P. xantholepis*
- 21b—Rhizinae dichotomously branched (at least some of them)
- 48a—Thallus isidiate
- 49a—Isidia inflated pustulate, hollow, breaking at top, medulla
C—, KC +orange13. *P. dactylifera*
- 49b—Isidia cylindrical, not inflated at top
- 50a—Medulla K+red or yellow red in parts
- 51a—Medulla K+red, lobes sublinear, spores
15—21 μ m long, norstictic acid present.....47. *P. rhabdiformis*
- 51b—Medulla K+yellow red in parts, lobes
rotund to subrotund, norstictic and sala-
cinic acid present5. *P. awasthii*
- 50b—Medulla K—
- 52a—Medulla P+red
- 53a—Medulla C+red (gyrophoric & proto-
lichesterinic acid present)26. *P. incognita*
- 53b—Medulla C—29. *P. koyaensis*
- 52b—Medulla F—
- 54a—Medulla C+red (gyrophoric acid
present)37. *P. neodissecta*
- 54b—Medulla C—
- 55a—Medulla KC+rose or orange
- 56a—Barbatic acid, 4-0-demethyl—
barbatic acid present.....39. *P. orientalis*
- 56b—Barbatic acid present with ob-
tusatic, norobtusatic acids.....25. *P. imbriculata*
- 55b—Medulla KC—27. *P. infirma*
- 48b—Thallus lacking isidia
- 57a—Thallus pustulate, pustulate-sorediate or sorediate
- 58a—Medulla pigmented, yellow to ochraceous
- 59a—Pigmented medulla K+purple, spores 7—14 μ m
long22. *P. formosana*
- 59b—Pigmented medulla K—.....18. *P. endochlora*
- 58b—Medulla white

- 60a—Medulla K+red, thallus pustulate, pustules breaking and falsely becoming sorediate, salacinic and norstictic acids present.....16. *P. dodapetta*
- 60b—Medulla K— or +yellow
- 61a—Medulla P+orange
- 62a—Medulla K+yellow, spores 6—7 μ m long, stictic and constictic acid present.....63. *P. thryptica*
- 62b—Medulla K—, protocetraric acid present...45. *P. pseudosinuosa*
- 61b—Medulla P—
- 63a—Medulla C+rose or red, lobes apically pustulate-sorediate, gyrophoric acid present46. *P. revoluta*
- 63b—Medulla C—, KC+red
- 64a—Thallus pustulate-sorediate, barbatic acid present20. *P. exsecta*
- 64b—Thallus with isidia-like inflated pustules, breaking at top and falsely appearing sorediate, physodic acid present 13. *P. dactylifera*
- 57b—Thallus lacking pustules and soredia
- 65a—Medulla K+red, P+orange, spores 6—9 μ m long.....58. *P. sublaevigata*
- 65b—Medulla K— or +faint brownish
- 66a—Medulla pigmented yellow-ochraceous, K— spores 13—20 μ m long..... 49. *P. rigidula*
- 66b—Medulla white
- 67a—Medulla P+orange or orange red
- 68a—Thallus large, up to 20 cm in diameter, coriaceous, apothecia not known.....52. *P. scytodes*
- 68b—Thallus small, 3—4 cm in diameter, apothecia up to 2 mm in diameter, spores 18—28 μ m long2. *P. adducta*
- 67b—Medulla P—
- 69a—Thallus maculate, medulla C+red or—, KC +red, barbatic acid present, spores 11—16 μ m long.....41. *P. physcioides*
- 69b—Thallus emaculate
- 70a—Medulla C+rose or red
- 71a—Thallus saxicolous, small, spores 12—17 μ m long, gyrophoric and protolichsterinic acids present : 42. *P. pindarensis*
- 71b—Thallus corticolous
- 72a—Thallus large coriaceous, apothecia large, spores 6—9 μ m long53. *P. scytophylla*
- 72b—Thallus small, thin, spores 12—18 μ m long.....43. *P. pluriformis*
- 70b—Medulla C—
- 73a—Medulla KC+orange red
- 74a—Alektoronic acid present, spores 10—13 μ m long.....14. *P. degelii*
- 74b—Barbatic acid present
- 75a—Amphithecium smooth....32. *P. massartii*
- 75b—Amphithecium rugose....7. *P. bostrychodes*
- 73b—Medulla KC—, spores 11—21 μ m long, pro.lichsterinic acid present21. *P. flexilis*

1. **Parmelia adaugescens** Nyl.

Lich. Jap. 28, 1890; *Zahlbr. Cat. Lich. Univ.* 6: 150, 1930.

The taxon has been reported from Sikkim by KUROKAWA (1966), but we have not been able to collect any specimen conforming to its description. *Parmelia adaugescens* Nyl. is subsimilar to *P. marmariza* in the presence of dense maculations, but differs in sparser pseudocyphellae, upper surface conspicuously cracked and the pseudocyphellae mostly laminar. The spores in the taxon have been stated to be $21-25 \times 11-14 \mu\text{m}$ by NYLANDER in the type description.

Parmelia pseudomarmariza which has been described elsewhere in this paper, has spores corresponding to the size of *P. adaugescens* but the thallus is not conspicuously cracked like that of *P. adaugescens*.

2. **Parmelia adducta** Nyl.

Flora, 68: 610, 1885; *Zahlbr. Cat. Lich. Univ.* 6: 151, 1930.

Hypotrachyna adducta (Nyl.) Hale, *Phytologia*, 28: 340, 1974.

Plate 7, Fig. 5

Thallus corticolous, foliose, loosely to closely adnate to substratum, 3-4 cm in diameter, \pm coriaceous, ashy grey to grey, irregularly sinuate lobate, lobes 2-3 mm wide, short, rounded to notched, margin eciliate; upper surface smooth; isidia and soredia absent; lower side black, densely rhizinate up to the margin; rhizinae simple when directly attached to substratum, along marginal notches when free they are shortly dichotomously branched, black; medulla white. Apothecia numerous, dense to crowded, 1-1.5 mm in diameter, sessile, constricted at base, concave; disc brown; amphithecium smooth; hymenium 80-100 μm high; asci 8 spored; spores colourless simple, oval ellipsoid, $18-28 \times 11-13 \mu\text{m}$; epispore wall slightly thickened.

Thallus K+yellow; medulla K—, C—, KC—, P+red; atranorin and protocetraric acid present.

Parmelia adducta is distinguished by its small sized thallus with dense, concave, small apothecia with large spores. In small sized apothecia, it somewhat resembles *P. flexilis* but that species has its medulla P—, with protolichesterinic acid. The taxon is known from Himalayas only.

Specimens examined:

West Bengal—Darjeeling district, Darjeeling, alt. 1950 m, on twigs of tree, AWASTHI 3105 (AWAS)—vidi HALE; Tiger Hill, alt. 2250 m, on bark of shrub, AWASTHI 64. 127 (AWAS); Kalimpong, on way to Munsong, alt. 1650 m, on tree bark, AWASTHI & AGARWAL 67. 281 B (LWU); below Sandakpoo, alt. 3300 m, on twigs, AWASTHI & AGARWAL 67.362 B (LWU). Taxon also reported from Darjeeling by KUROKAWA (1966, p. 606).

Extra-Indian specimen examined:

Nepal—No precise loc., 1951, BANERJEE 1397 (AWAS)—vidi KUROKAWA.

3. **Parmelia aptata** Kremp.

In Nyl. *Flora*, 52: 291, 1869; *Zahlbr. Cat. Lich. Univ.* 6: 224, 1930.

Pseudoparmelia aptata (Kremp.) Hale, *Phytologia*, 29: 189, 1974.

Plate 4, Fig. 3

Thallus corticolous, foliose, closely adnate to substratum, 4-6(8) cm in diameter, coriaceous, ashy grey to dark grey, irregularly sinuate lobate, lobes subrotund, subimbricate and involuted, 2-4 mm wide; margin eciliate; upper surface plane, dull, smooth to rough, minute fleck soralia on the lamina and better developed soralia along margin and in submarginal area, pustules absent; soredia \pm granular; lower side black, rough, rhizinate up to the margin; rhizinae short, simple. Thallus ca 120-200 μm (400 μm in

central part) thick, medulla mostly white, yellowish near soralia. Apothecia usually present, 2-3 mm in diameter, adnate, constricted at base, imperforate; disc dark brown; amphithecium rugose, sorediate; hymenium 60-75 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, 8-14 \times 5-7 μ m.

Thallus K+yellow; medulla K—, C—, KC—, P—; atranorin present.

Parmelia aptata resembles *P. aurulenta* in the somewhat yellowish medulla and presence of soredia, but while *P. aurulenta* usually has pustules which become sorediate there are no pustules in *P. aptata*. The soralia in *P. aptata* are smaller in dimensions. The taxon is distributed in tropical regions of the world.

Specimens examined:

Uttar Pradesh—Almora district, Almora, alt. 1500 m, on bark of Pine tree, A. M. AWASTHI 463 (AWAS)—fertile, det. Kurokawa; Ranikhet to Chaubattia road, 1600 m, on bark of Pine tree, AWASTHI 3545 (AWAS)—fertile; AWASTHI & DANGE 74.93 (LWU)—sterile; Pithoragarh district, Askote, village Naret, alt. 1400 m, on bark of tree, AWASTHI 3291 B(AWAS)—det. HALE.

4. *Parmelia aurulenta* Tuck.

Amer. J. Arts & Sci. ser. 2, 25: 424, 1858; *Zahlbr. Cat. Lich. Univ.* 6: 152, 1930.

Parmelina aurulenta (Tuck.) Hale, *Phytologia*, 28: 482, 1974.

Plate 4, Fig. 5

Thallus corticolous, rarely saxicolous, foliose, closely adnate to substratum, 4-6 (8) cm in diameter yellowish grey, grey to bluish dark grey, irregularly sinuate lobate, lobes sub-linear to subrotund, 1-3 mm wide at periphery and 5 mm or wider inwards, subascending, imbricate, margin dentate to truncate, ciliate at the notches or axils, cilia short; upper surface smooth, dull to shining at margins, marginal area bluish black rimmed; thallus pustulate and pustules bursting to become sorediate, or soralia marginal to submarginal, rounded to elongated, with granular soredia; lowerside black, densely rhizinate, rhizinae simple to squarrosely branched; medulla yellowish pigmented. Apothecia rarely present, adnate, 2-5 mm in diameter; disc dark brown; amphithecium rugose; margin sorediate; hymenium 50-60 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, 12-17 \times 6-10 μ m.

Thallus K+yellow; medulla K—or+yellow, C—, KC—, P—; atranorin, (an unknown yellow pigment also reported by HALE).

Parmelia aurulenta is characterized by the yellow pigmented medulla, and pustulate-sorediate upper cortex. The taxon is widely distributed in the subtropical regions of the world.

Specimens examined:

Unless stated otherwise specimens are sterile.

Himachal Pradesh, Chhika to Manali, on bark of *Cedrus*, *Picea* tree trunks, HÖEG 1492, 1497, 1861 (AWAS)—det. Hale, 1965. Tamil Nadu—Kodaikanal, Golf Club area, alt. 2250m, SINGH 70.616 (LWU). Uttar Pradesh—Almora district, Ranikhet to Chaubattia, alt. 2000 m, on tree, AWASTHI & DANGE 47.108 (LWU); Dehradun district, Mussoorie, on bark, AWASTHI 3815 (AWAS)—det. HALE; AWASTHI 3803 (AWAS)—well fertile, det. HALE; Nainital district, Snow View at Nainital, on tree trunk, AWASTHI & DANGE 72.4 (LWU); Pithoragarh district, Askote, on bark of trees, AWASTHI 3970 (AWAS)—det. HALE; Naret, over boulder, AWASTHI 2705 (AWAS)—vidi Hale; on way to Poornagiri, on *Shorea robusta* bark, AWASTHI 3374 (AWAS)—det. HALE, 1967; West Bengal—Darjeeling, Observatory hill, alt. 2100 m, on tree trunk, AWASTHI 3869 (AWAS)—vidi HALE. Taxon also reported from Darjeeling by KUROKAWA (1966, p. 607).

5. *Parmelia awasthii* (Hale & Patw.) Awasthi comb. nov.

Hypotrachyna awasthii Hale & Patwardhan, *The Bryologist*, 77: 637, 1974.

Thallus corticolous, foliose, loosely adnate to substratum, 4-6 cm in diameter, mineral grey to grey, irregularly sinuate lobate, lobes rotund, 5-10 mm wide, with short minute cilia

at the axils or notches; upper surface smooth, dull, isidiate; isidia sparse to dense, simple to branched, young isidia black tipped, darker than the thallus; lower side black, densely rhizinate, marginal area brown black, sparsely rhizinate or sometimes almost erhizinate; rhizinae simple near margin, inwards dichotomously branched; medulla white. Apothecia absent in specimens examined (Rare, adnate, 1-2.5 mm in diameter, hymenium 50-60 μ m, spores simple, oval, $10 \times 8 \mu$ m—HALE and PATWARDHAN (l.c.,).

Thallus K+yellow; medulla K+deep yellow to reddish, C—; KC+red, P+red; atranorin, salacinic acid and norstictic acid present.

Parmelia awasthii exhibits a close resemblance to *P. wallichiana* in the rotund lobes, isidiate upper surface and to some extent in the colour reactions, but while *P. wallichiana* has only atranorin and salacinic acid and simple to squarrose branched rhizinae, *P. awasthii* contains atranorin, salacinic and norstictic acids and the rhizinae are dichotomously branched.

Specimens examined:

Maharashtra—Mahabaleshwar, Wilson Point, alt. ca. 1400 m, on twigs of shrubs, AWASTHI 4041 (AWAS: Holotype). Tamilnadu—Nilgiri hills, Naduvattam, Cinchona Plantation, alt. 1500 m, on bark of tree, SINGH 72.107 (LWU).

6. ***Parmelia borrieri* (Sm.) Turn.**

In Sm. & Sowarb. *Engl. Bot.* 25: table 1780. 1807; Zahlbr. *Cat. Lich. Univ.* 6: 153, 1930; Hale, *Svensk Bot. Tidsk.* 59: 38, 1965.

Lichen borrieri Sm. in Sm. & Sowarb, *Engl. Bot.* 25: tab. 1780. 1807.

Plate 2, Figs. 2 & 4

Thallus corticolous or saxicolous, foliose, loosely adnate to substratum, 6-8 cm in diameter, radiatingly lacinate lobate, bluish grey, grey to ashy grey; lobes 2-4 (6) mm wide, ascending, often imbricate, margin subrotund, crenate-dentate, eciliate; upper surface smooth to rough, white pseudocyphellate, pseudocyphels distinct in submarginal area, eventually become capitate sorediate, soralia marginal and laminal, marginal sinuous, laminal soralia often becoming confluent; lower side black to brown black, marginal area pale brown to yellowish; rhizinae sparse to dense in the greater central part, marginal area rhizinate-papillate or sometimes erhizinate, sometimes the marginal area also brown black; rhizinae pale brown to brown, simple, unbranched, or thickened and \pm furcate at the extremities; medulla white. Apothecia absent in the specimens examined.

Thallus K+yellow; medulla K—, C+red, KC+red, P—; atranorin and gyrophoric acid present.

Parmelia borrieri closely resembles *P. subrudecta* in pseudocyphellate and sorediate condition and the C+reaction. The black underside of *P. borrieri* is not always distinctive to separate it from *P. subrudecta*, which has a pale underside; the lowerside of *P. borrieri* also tends to be light brown in some cases. The presence of gyrophoric acid distinguishes it from *P. subrudecta* which has lecanoric acid.

Specimens examined:

Himachal Pradesh—Kulu, by roadside, alt. 1800 m, HÖEG 1464 A, on stone, HÖEG 1458, 1454 (AWAS); near Manali, on tree, HÖEG 1851 (AWAS)—det. HALE s. n. *Parmelia pseudoborrieri* Asah.; AWASTHI *et al.* (LWU); Parbati river valley, Pulga, over rocks, alt. 2100 m, AWASTHI & DANGE 75.188 (LWU); Kulu, on boulders, AWASTHI & DANGE 75.040, 75.044 (LWU). Uttar Pradesh—Almora district, alt. 1650 m, on bark of *Celtis* tree, AWASTHI 3472 (AWAS)—det. HALE; Dehra Dun district, Mussoorie alt. 1800 m, on bark, JOSHI 75.240 (LWU). Tamil Nadu—Nilgiri hills, Ootacamund Bot. Garden, on bark of tree, AWASTHI & SINGH 71.282 (LWU)—pr. p.; Palni hills, Kodaikanal, Pillar Rocks, alt. 2100 m, on bark of tree, SINGH 70.737 (LWU).

7. *Parmelia bostrychodes* Zahlbr.

Ann. Crypt. Exot. 1: 203, 1928; and *Cat. Lich. Univ.* 6: 157, 1930.

Hypotrachyna bostrychodes (Zahlbr.) Hale, *Phytologia*, 28: 340, 1974.

Plate 7, Fig. 4

Thallus corticolous, rarely saxicolous, foliose, loosely adnate to attached to substratum, mineral grey to pale grey, 6-8 cm in diameter, subdichotomously sinuate lobate; lobes sublinear, \pm uniformly contiguous, 1.5-3 (4) mm wide, discrete; upper surface plane, emaculate, smooth to faintly rugulose; isidia and soredia absent; lower side black, densely rhizinate up to the margin, rhizinae densely dichotomously branched, often projecting beyond the lobe margins; medulla white. Apothecia common, restricted in the central part of the thallus, substipitate, 8-15 mm in diameter, larger apothecia irregularly cracked lobate, imperforate; disc dark brown to chestnut brown; amphitheciium smooth to rugose; hymenium 50-60 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, 10-16 \times 6-7 μ m.

Thallus K+yellow, medulla K—, C—, KC+orange red, P—; atranorin and barbatic acid present.

Parmelia bostrychodes very closely resembles *P. massarti* in the nature of lobes, the apothecia, the chemical substances and reactions. The slight difference lies in the \pm loosely adnate thallus, rugose amphitheciium in case of *P. bostrychodes*. It is difficult to distinguish the two taxa in sterile condition.

Specimens examined:

Uttar Pradesh—Almora district, Loharkhet,—Dhakuri, alt. 2250 m, on bark of tree, AWASTHI 7558 (AWAS): Dwali to Phurkia route, alt. 3000 m, over boulder, AWASTHI 7645 (AWAS). West Bengal—Darjeeling district, above Kurseong, on bark of tree, alt. 1650 m, AWASTHI 3913 (AWAS)—det. Kurokawa; Dow hill, alt. 1900 m, on bark of *Cryptomeria japonica* tree, AWASTHI & AGARWAL 66.260 (LWU); Tiger Hill, alt. 2500 m, on shrubs, AWASTHI & AGARWAL 67.25 (LWU).

8. *Parmelia bulbochaeta* Hale

In Hale & Kurokawa, *Contr. U. S. Nat. Herb.* 36:138, 1964, Plate 1, fig. 7.

Bulbothrix bulbochaeta (Hale) Hale, *Phytologia*, 28: 480, 1974.

Plate 5, Fig. 1

Thallus corticolous, foliose, closely adnate to substratum, 3-6 cm in diameter, coriaceous, grey, irregularly lobed; lobes sublinear, 1.5-2.5 mm wide, sinuate lobate; margin entire, conspicuously bulbate ciliate; cilia close with thick base; upper surface plane, emaculate, densely black punctate; isidia and soredia absent; lower side black, densely rhizinate up to the margin; rhizinae black, dichotomously branched; medulla white. Apothecia scarce, 2-3 mm in diameter, constricted at base, margin minutely lobulate, disc brown, amphitheciium smooth, hymenium 40-50 μ m high, asci 8 spored; spores colourless, simple, oval, 5 \times 4 μ m.

Thallus K+yellow; medulla K—, C—, KC—; P—; only atranorin present.

Parmelia bulbochaeta is distinctive in the presence of prominent bulbate cilia, small spores and negative to colour reactions in medulla. It has so far been known from India only.

Specimens examined:

Tamil Nadu—Palni hills, Shembaganur, Perumal Coffee Plantation, alt. 1600-1700 m, on bark, AWASTHI 4347 (AWAS—Holotype); Shembaganur, S. H. College compound, alt. 1800 m, AWASTHI 4275 (AWAS)—det. HALE; Shembaganur, over rock (?) FOREAU 3777 (AWAS).

9. **Parmelia carneopruinata** Zahlbr.

Sitz Kais. Akad. Wiss. Wien, Math. Nat. Kl. 111 (1): 419, 1902, tab. 1, fig. 5; *Cat. Lich. Univ.* 6: 158, 1930. *Pseudoparmelia carneopruinata* (Zahlbr.) Hale, *Phytologia*, 29: 189, 1974.

Thallus corticolous, foliose, closely adnate to substratum, 5-8 cm in diameter, grey to dark olivaceous grey, irregularly compactly short lobed; lobes sublinear, 1-2 mm wide, margin brown-black rimmed, eciliate; upper surface reticulately wrinkled, cracked in central part; soralia laminal, developed along the margin of the cracks, rather dense in the central part of the thallus; soredia coarse granular; lower side black, sparsely rhizinate; rhizinae short, simple; marginal zone on under side dark brown; medulla white to yellowish. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K+yellow; C—, KC—, P+reddish; atranorin and stictic acid present.

Parmelia carneopruinata is distinguished from *P. crozalsiana* by the narrower sublinear lobes, more prominent wrinkles and granular soredia.

Specimens examined:

Tamil Nadu—Nilgiri hills, Cocnoor, alt. 1680 m, by road side, on bark of tree, AWASTHI & SINGH 70.1318, 70.1373 (LWU); along road, alt. 1650 m, on bark, SINGH 71.832 (LWU).

10. **Parmelia cirrhata** Fr.

Syst. Orb. Veget. 1: 383, 1825; Zahlbr. *Cat. Lich. Univ.* 6: 59, 1930.

Plate 3, Fig. 4

Thallus corticolous, saxicolous or terricolous, foliose, suberect to pendulous, dichotomously laciniate lobate, grey to dark grey, lobes linear elongate, much variable in width, apically tapering, thin to thick, 2-4 (6) mm wide; upper surface smooth to rugose; margin ciliate, cilia long, simple to branched; isidia and soredia absent; lower side black, lacunose in older part, pale brown to dark brown near apices, concave canaliculate; rhizinae absent, but the marginal cilia may be confused for the rhizinae; medulla white. Apothecia laminal, sessile to substipitate, 1-6 mm in diameter, entire to cracked; disc dark brown; amphithecium smooth; asci 8 spored; spores colourless, simple, oval ellipsoid, $15-30 \times 7-12 \mu\text{m}$.

Thallus K+yellow; medulla K+red to brownish red, C—, P+orange red; atranorin, salacinic acid and protolichesterinic acid present.

Parmelia cirrhata closely resembles *P. nepalensis* in general habit of laciniae, the only difference is the absence of rhizinae in *P. cirrhata* and their presence in *P. nepalensis*. Sometimes the dense branched marginal cilia may be confused as the rhizinae on lower side. The taxon is widely distributed like *Parmelia nepalensis* and often the two may grow together. The specimens exhibit a great deal of variation in the thickness of thallus, the size of laciniae, and the size of apothecia. In some cases the young thalli may not be erect to pendulous and hence such a type of thallus needs to be keyed out differently as done in the keys.

Specimens examined:

Himachal Pradesh—Dharamshala, on *Quercus incana*, SHARMA (AWAS): Kulu division, Parbati river valley, above Pulga, alt. ca. 2200—3150 m, AWASTHI & DANGE 75.155, 75.211, 75.212, 75.260 (LWU). Meghalaya—Shillong, Mophlong forest, on tree, AWASTHI (AWAS). Tamil Nadu—Nilgiri hills, Avalanche, SINGH 71.347 (LWU); Emerald road, SINGH 73.469 (LWU); Naduvattam, on twigs, SINGH 72.105 (LWU); Nilgiri Peak, alt. 2100 m, SINGH 72.8, 72.22 (LWU); Ootacamund to Kotagiri road, SINGH 71.1048 (LWU); Palni hills, Kodaikanal, alt. 2100 m, on trees, HÖEG 2521 (AWAS); SINGH 70.564 (LWU). Sikkim—alt. 1800 m, on twigs, AWASTHI 17, 23, 24, 25, (AWAS); near Chhangu, alt. 3000 m, on twigs, AWASTHI 26, 30, 39 (AWAS). Uttar Pradesh—Almora district, Dhakuri to Phurkia, on way to Pindari, AWASTHI 7603, 7761 (AWAS); near Kasardevi, alt. 1800 m, on *Pinus* bark, AWASTHI 3446 (AWAS); Ranikhet to Chaubattia, alt. 1800 m, AWASTHI 3566, 3567 (AWAS); Dehra Dun district, alt. 1800—2100 m, AWASTHI 3801 (AWAS);

Mussoorie, JOSHI 75.104, 75.169, 75.258, 75.323, 75.380 (LWU); Naini Tal district, Naini Tal, alt. 2400 m, AWASTHI & DANGE 74.28, 74.76 (LWU); Pithoragarh district, Askote, AWASTHI 3437 (AWAS); West Bengal —Darjeeling district, near Batasi, alt. 1650 m, on tree, AWASTHI 16 (AWAS); Palmajua, AWASTHI 15 (AWAS); Sandakhpoo, alt. 3000 m, on twigs, AWASTHI 13, 165 (AWAS); Tiger hills, alt. 2250 m, BOSE 60.34 (AWAS); AWASTHI 3134 (AWAS); Kurseong, alt. 1600 m, AWASTHI & AGARWAL 66.270 (LWU).

The taxon has been reported from Sikkim by KUROKAWA (1966, p. 607).

Extra-Indian specimens examined:

Nepal, E. Nepal—Cho Oyu, near Mahabir village, alt. 2600 m, on shrub, ROLLA RAO 13638 (AWAS); Thengboche, alt. 3990 m, ROLLA RAO 13740 (AWAS); no precise locality, BANERJEE 1407 (AWAS).

11. **Parmelia crozalsiana** B. de Lesd.

In Harm. Lich. de France, 555, 1910; Zahlbr. Cat. Lich. Univ. 6: 237, 1930.

Pseudoparmelia crozalsiana (B. de Lesd.) Hale, *Phytologia*, 29: 189, 1974.

Plate 4, Fig. 4

Thallus corticolous, foliose, loosely adnate to substratum, 4-6 cm in diameter, ± coriaceous, yellowish grey, mineral grey to ashy grey, irregularly lobate; lobes imbricate, subrotund, slightly ascending, 2-4 mm wide, dentate to truncate at apices, margin eciliate; upper surface minutely reticulately wrinkled or ridged (under lens), distinct in apical part, turning to ± scrobiculate condition in older part, and then sometimes cracked; soralia laminal to submarginal, ± capitate, generally present in the marginal area in the central part of the thallus; soredia farinose; lower side black, uniformly rhizinate up to the margin; rhizinae short, black, simple; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K+yellowish, C—, KC—, P+orange red; atranorin and stictic acid present.

Parmelia crozalsiana externally closely resembles *P. carneopruinata* in the reticulately ridged upper cortex, but is distinguished by wider lobes, less prominent wrinkles and ± farinose soredia.

Specimens examined:

Tamil Nadu—Nilgiri hills, Coonoor, alt. 1700 m, AWASTHI & SINGH 70.1327, 70.1388 (LWU); SINGH 71.829 (LWU); Kotagiri to Kodanad, near Finger Post, ca. 1800 m, on bark of tree, SINGH 71.940 (LWU); Mettupalayam road, Adderly Shola, near Hill Grove, on bark of tree, SINGH 71.845 (LWU); Palni hills, Shembaganur, S. H. College compound, alt. 1800 m, on bark of tree, AWASTHI 4276 (AWAS)—det. HALE, 1965; on way to Perumal Peak, on bark, SINGH 70.1080 (LWU); Perumal Coffee Plantation, alt. 1500 m, on bark of tree, SINGH 70.1117 (LWU); Kodaikanal road, Tamtamparai to Nandagarai, alt. 700 m, on bark, SINGH 70.1250 (LWU).

12. **Parmelia dactylifera** Vain.

Étud. Lich. Brésil. 1: 57, 1890; Zahlbr. Cat. Lich. Univ. 6: L169, 1930.

Hypotrachyna dactylifera (Vain.) Hale, *Smithsonian Contr. Bot.* No. 25: 30, 1975.

Thallus corticolous, foliose, closely adnate to substratum, 5-8 cm in diameter, mineral grey to grey, subdichotomously sinuate lobate, lobes sublinear, 1-3 mm wide, discrete to subimbricate in central part of thallus, apices truncate, margin eciliate; upper surface smooth shining at periphery, inwards densely isidiate; isidia large inflated, clavate, up to 1 mm long, hollow, breaking at the top and then crateriform with coarse soredia-like granules in a mass (apparently the broken pieces of the cortex of isidia); lower side black, moderately rhizinate up to the margin or a narrow brown marginal zone with rhizinal papillae; rhizinae short, dichotomously branched; medulla white. Apothecia very rare (only one seen), 3 mm in diameter, hymenium 40-50 µm high; spores colourless, simple, oval ellipsoid, 9-12×4.5-6.5 µm.

Thallus K+yellow; medulla K—, C—, KC+reddish, P—; atranorin and physodic acid present.

Parmelia dactylifera is distinctive in the inflated large hollow isidia which break at the top. The taxon is known from S. America.

Specimens examined:

Meghalaya—Shillong, Upper Shillong peak, alt. 1800 m, on bark of tree, AWASTHI 6451 (AWAS)—fertile; Shillong to Jowai route, alt. ca. 1600 m, on bark of Pine tree, AWASTHI 8011 B, 8028 (AWAS)—sterile.

13. ***Parmelia degelii* Hale**

In Hale and Kurokawa, *Contr. U. S. Nat. Herb.* 36: 170, 1964.

Hypotrachyna degelii (Hale) Hale, *Smithsonian Contr. Bot.* No. 25: 31, 1975.

Thallus corticolous, foliose, closely adnate to substratum, 6—10 cm in size, grey to olivaceous grey, subdichotomously sinuate lobate; lobes short, sublinear, 1—3 mm wide, apically furcate; upper surface plane, smooth to rugulose, faintly maculate; isidia and soredia absent; lower side black, densely rhizinate up to the margin; rhizinae dichotomously branched; medulla white. Apothecia common, up to 3 mm in diameter, sub-stipitate; margin crenate inflexed; disc dark brown, amphithecium smooth; hymenium 55-70 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, 10—13 \times 5—9 μ m.

Thallus K+yellow; medulla K—, C—, KC+red, P—; atranorin and alectoronic acid present.

The taxon is distinctive in short lobes, absence of isidia and soredia, and presence of alectoronic acid. It is distributed in America and Africa.

Specimen examined:

Tamil Nadu—Nilgiri hills, on way from Kilkotagiri to Konada, alt. 1800 m, on bark of tree, AWASTHI & SINGH 71. 23 (LWU).

14. ***Parmelia denegans* Nyl.**

Acta Soc. Sci. Fenn. 26(10): 6, 1900; *Zahlbr. Cat. Lich. Univ.* 6: 164, 1930.

Parmelina denegans (Nyl.) Hale, *Phytologia*, 28: 482, 1974.

Plate 8, Fig. 1

Thallus corticolous, foliose, closely adnate to substratum, 3-4 cm in diameter, rather delicate, yellowish grey to grey, irregularly lobed; lobes 3—4 mm wide, imbricate; margin ciliate, dentate, upper surface plane in marginal region, inwards often much convoluted with pustule like growth on the surface which break up releasing a powdery soredia-like mass; isidia and soredia absent; lowerside black, rhizinate up to the margin; rhizinae simple; medulla deep yellow to ochraceous. Apothecia numerous, sessile, constricted at base, up to 4 mm in diameter; disc imperforate, dark brown; amphithecium smooth; hymenium 50-60 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, 9—12 \times 5—7 μ m.

Thallus K+yellow; medulla pigmented K+purple violet, C—, P—. The taxon does not seem to have any relative amongst the group in its delicate nature, pigmented medulla and absence of isidia and soredia. The isidiate *P. perisidians* shows the closest resemblance in the medulla, but the isidia distinguish that taxon.

Specimen examined:

Tamil Nadu—Palni hills, Kodaikanal to Berijam route, alt. 2175 m, on bark of tree, FOREAU 4128 (AWAS)—det. HALE.

15. ***Parmelia dissecta* Nyl.**

Flora, 65: 451, 1882; *Zahlbr. Cat. Lich. Univ.* 6: 165, 1930.

Parmelina dissecta (Nyl.) Hale, *Phytologia*, 28: 482, 1974.

Thallus corticolous, foliose, closely adnate to substratum, 4-6 cm in diameter, mineral grey to grey, subdichomously sinuate lobate, lobes linear to sublinear, 1-2 (4) mm wide, central part lobes somewhat wider than peripheral ones, width \pm uniform, lobes truncate to rounded; margin ciliate in the axils or notches; upper surface smooth, emaculate, densely isidiate in the central part; isidia initially simple, concolorous with thallus, later densely branched, cylindrical, up to 1.5 mm tall; lower side black, smooth to somewhat lacunose in peripheral part, densely rhizinate in the central part, marginal zone with rhizinal papillae; rhizinae black, simple. Thallus 75-100 μ m thick, medulla white. Apothecia rare (seen in a single specimen), adnate, constricted at base, up to 2 mm in diameter; disc brown; margin distinct; amphithecium smooth; hymenium ca. 50 μ m high, asci 38×19 μ m, 8 spored; spores colourless, simple, ellipsoid, $9-11 \times 5.7$ μ m. (The type specimen vide NYLANDER was sterile).

Thallus K+yellow; medulla K—, C+red, KC+red, P—; atranorin and gyrophoric acid present.

Parmelia dissecta is distinctive in being densely isidiate and medulla C+red (gyrophoric acid). The narrow lobes are also distinctive. In external habit it shows some resemblance to *P. orientalis*, *P. infirma*, and *P. incognita* but the latter species have dichotomously branched rhizinae.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Meghalaya—Shillong, Jowai route, on Pine bark, AWASTHI 8008 (AWAS). Tamil Nadu—Nilgiri hills, on way to Doddabetta peak, alt. 1800 m, SINGH 73.371 pr. p. (LWU); Doddabetta peak, alt. 2450 m, on tree trunk, AWASTHI & SINGH 71.157 (LWU); Kodanad, alt. 2000 m, on tree trunk, AWASTHI & SINGH 70.1495 (LWU); Kodanad to Kilkotagiri, on tree, AWASTHI & SINGH 71.76 (LWU); Naduvattam Cinchona plantation, SINGH 72.93 pr. p. (LWU); Palni hills, Kodaikanal, alt. 2100 m, on bark of tree, HÖEG 2528 (AWAS)—det. Kurokawa; Kodaikanal, on way to Pillar Rocks, on tree trunks, AWASTHI & SINGH 70.194 (LWU)—fertile; Kodaikanal, SINGH 70.767 (LWU).

Reported from Darjeeling by KUROKAWA (1966, p. 607).

16. ***Parmelia dodapetta*** (Hale & Patw.) Awasthi comb. nov.

Hypotrachyna dodapetta Hale & Patwardhan, *The Bryologist*, 77: 637, 1974.

I have examined only the isotype specimen, and no other collection has been seen by me, consequently the following description has been based on the type description of HALE and PATWARDHAN (l.c.).

Thallus corticolous, foliose, closely adnate to substratum, grey, lobes 5-10 mm wide, rounded; upper surface pustulate; pustules fragile, erumpent, and then appearing as if sore-diose; lower side black, rhizinate throughout the under side, marginal zone brown; rhizinae dichotomously branched; medulla white. Apothecia unknown.

Thallus K+yellow; medulla K+red, C—, P+ orange red; atranorin, salacinic acid and norstictic acid present.

Specimen examined:

Tamil Nadu—Nilgiri hills, near Doddabetta Peak, alt. 2600 m, on bark of *Cupressus*, HALE & PATWARDHAN 40218 (AWAS—isotype).

17. ***Parmelia ecaperata*** Müll. Arg.

Flora, 74: 378, 1891; *Zahlbr. Cat. Lich. Univ.* 6: 136, 1930.

Pseudoparmelia ecaperata (Müll. Arg.) Hale, *Phytologia*, 29: 190, 1974.

Plate 4, Fig. 2

Thallus corticolous, rarely saxicolous, foliose, coriaceous, closely adnate to substratum, centrally somewhat inseparable from substratum, but peripherally \pm free, 6-8 cm in diameter, irregularly sinuate lobate, yellowish grey to grey; lobes sublinear, truncate to crenate, or multifid, (1) 2-5 mm wide; margin eciliate; upper surface smooth, plane, sometimes cracked in older parts, rarely \pm maculate; densely isidiate, isidia initially simple with black tips, but later become coralloid branched and dense, externally appearing darker, isidia up to 1 mm long; lower side black with short, black, thick rhizinae, marginal 1-2 mm wide zone brown black, smooth, erhizinate or with rhizinal papillae. Thallus thickness much variable, medulla white. Apothecia rare (seen only in two specimens), adnate, constricted at base, \pm urceolate; disc brown; amphithecium densely isidiate; hymenium 45-60 μ m high; asci $37 \times 12 \mu$ m, 8 spored; spores colourless, simple, oval to ovoid, $8-10 \times 6-8 \mu$ m.

Thallus K+yellowish; medulla K— C—, KC—, P—; usnic and divaricatic acids present.

Parmelia ecaperata is characterized by the yellowish grey thallus, which is densely isidiate and is negative to common colour reagents. It is widely distributed in subtropical regions of the world.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Tamil Nadu—Nilgiri hills, Ootacamund, Bot. Garden, alt. 2100 m, on tree trunk, AWASTHI 4431, 4432 (fertile) (AWAS)—det. HALE, 1965; Palni hills, Kodaikanal, alt. 2100 m, HÖEG 2516 A, 2522 (AWAS)—det. HALE; Pillar Rocks area, on Pinetree, AWASTHI & SINGH 70.218 (LWU); SINGH 70.675 (LWU); Golf Club area, on bark, SINGH 70.621 (LWU); around lake at Kodaikanal, SINGH 70.780 A (LWU); Pambampuram, alt. 2251 m, on bark, SINGH 70.547 (LWU); Kodaikanal, La Providence, alt. 2100 m, on Pine tree, DEGELIUS As-256 (DEGEL); Shembaganur, on bark, FOREAU 3752 (AWAS)—fertile; on pear tree, SINGH 70.852 (LWU). Uttar Pradesh—Almora district, Ranikhet, alt. 1800 m, on Pine bark, AWASTHI 3609 (AWAS), Jageshwar, on Pine tree bark, AWASTHI 3496 (AWAS); Pithoragarh district, Askote, on Pine tree bark, AWASTHI 3972 (AWAS)—det. HALE.

The taxon has also been reported from Darjeeling by KUROKAWA (1966, p. 607).

18. *Parmelia endochlora* Leight.

Lich. Fl. Great Brit. 140, 1871; *Zahlbr. Cat. Lich. Univ.* 6: 165, 1930.

Hypotrachyna endochlora (Leight.) Hale, *Smithsonian Contr. Bot.* No. 25:34, 1975.

Plate 6, Fig 5

Thallus corticolous, foliose, loosely adnate to substratum, up to 10 cm in diameter, irregularly sinuate lobate, grey to dark grey; lobes 1-3 mm wide, much imbricated, margin ciliate; upper surface plane, smooth, shining to dull, sorediate; soralia submarginal, developing from pustules; soredia granular, dark; lower side black, sparsely rhizinate, rhizinae simple to subdichotomously branched, black; medulla yellow. Apothecia absent in specimen examined.

Thallus K+yellow; medulla K— C— KC+ reddish, P—.

Parmelia endochlora resembles *P. formosana* in yellowish pigmented medulla, but while in the former there is no reaction by K, in *P. formosana* the pigment is K+purple brown; moreover the habit of the lobes is different in the two taxa.

Specimen examined:

Tamil Nadu—Palni hills, Kodaikanal to Berijam route, alt. 2200 m, FOREAU 4129 (AWAS)—det. HALE, 1963.

19. **Parmelia expallida** Kurok.

Bull. Nat. Sci. Mus. Tokyo, 11 (2): 191, 1968, Plate I, Figs. 1-3.

Parmelina expallida (Kurok.) Hale, *Phytologia*, 28: 482, 1974.

The taxon based on a specimen from Formosa has also been reported from Takdah, Darjeeling district, West Bengal, by KUROKAWA (l.c.). We have not been able to collect any specimen conforming to the description of the species, and the following description is based on the type description by KUROKAWA as ready reference since the species will be found by others in Darjeeling area.

Thallus corticolous, glaucous grey, 5-7 cm across, subirregularly lobate, lobes sublinear, 1-3 mm wide, sparsely ciliate; upper surface smooth, emaculate, dark to black margined, densely isidiate; isidia cylindrical, simple to coralloid branched; lower side pale brown, moderately rhizinate up to the margin; rhizinae simple to rarely furcate; medulla white. Apothecia sessile, 2-5 mm in diameter; amphithecium isidiate; hymenium 85-95 μ m high; asci 8 spored; spores colourless, simple, ellipsoid, 14-17 \times 8-10 μ m.

Thallus K+ yellowish; medulla K—, C—, KC—, P—; atranorin and aliphatic acids present.

Due to the presence of furcate rhizinae the taxon is likely to be confused with *P. infirma*, *P. koyaensis*, and *P. incognita*; but *P. expallida* can be distinguished from them by the pale brown under side.

20. **Parmelia exsecta** Tayl.

London J. Bot. 6: 166, 1847.

Hypotrachyna exsecta (Tayl.) Hale, *Phytologia*, 28: 341, 1974.

Parmelia laevigata var. *exsecta*, Zahlbr. *Cat. Lich. Univ.* 6: 172, 1930.

Thallus corticolous, foliose, loosely to closely adnate to substratum, 6-8 cm in diameter, yellowish grey, grey to dark grey, subdichotomously to irregularly sinuate lobate; lobes sublinear, discrete to imbricate, (1) 2-5 mm wide, apex dentate; margins somewhat ascending; upper surface smooth to \pm shining at the apical region, emaculate, subapical region pustulate-soresiate; pustules initially grey to brown, and later crateriform with granular soredia, often several pustules present in the submarginal region of the lobules in the central part of thallus; lower side black, sparsely to densely rhizinate; rhizinae dichotomously branched, up to 2 mm long; medulla white. Apothecia rare, substipitate, up to 5 mm in diameter, imperforate; disc brown; amphithecium smooth; hymenium 50-70 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, 12.5-15.5 \times 6-8 μ m.

Thallus K+yellow; medulla K—, C—, KC+red, P—; atranorin and barbatic acid present.

Parmelia exsecta shows a close similarity to *P. revoluta* in the nature of pustulate-soresiate condition, but differs in the medulla C—, KC+red (barbatic acid present). It also shows some resemblance to *P. endochlora* in the general nature of lobes, but the medulla in *P. endochlora* is pigmented and does not possess barbatic acid. The taxon is widely distributed in tropical and subtropical region of the world.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Tamil Nadu—Nilgiri hills Avalanche, Emerald road, alt. 2100 m, on bark, SINGH 71.363 (LWU); Carriat Shola on way to Nilgiri Peak, alt. 2100 m, on bark, SINGH 72.1, 72.3 (LWU)—fertile; 72.11, 72.18 (LWU); Doddabetta peak ca. 2400 m, on Eucalyptus bark at base, AWASTHI & SINGH 71.99 71.170 (LWU), SINGH 72.129 71.1067 (LWU); Gudalur from Naduvattam, on bark, SINGH 73.633 (LWU); Avalanche, on bark

of Rhododendron tree trunk, AWASTHI & SINGH 71.260 (LWU); Opposite Mukurti Lake, on Rhododendron bark, SINGH 71.755 (LWU); Ootacamund to Mysore road, at about 15 km, on bark, AWASTHI 4539 (AWAS)—det. HALE, 1935; Bot. Garden, alt. 2100 m, AWASTHI 4446 (AWAS)—det. HALE, 1965; Konada tea estate; alt. 1800 m, AWASTHI & SINGH 71.60, 71.63 (LWU); Ootacamund to Kotagiri road, on bark, SINGH 71.1106 (LWU); Ootacamund to Doddabetta, SINGH 72.129 (LWU); Naduvattam Cinchona plantation, on Cinchona bark, SINGH 72.86, 72.103 (LWU); Upper Bhowani road from Avalanche, near Lakribetta, alt. 2400 m, on bark of tree, SINGH 71.694, 71.748 (LWU); Sholurmatta near Kilkotagiri, on bark, SINGH 71.894, 71.901, 71.911 (LWU); Palni hills, Kodaikanal, FOREAU 4146 (AWAS)—det. HALE, 1965; Kodaikanal to Berijam Road, alt. 2250 m, FOREAU & AWASTHI 4235 (AWAS)—det. HALE; Sirudamkanal Shola, FOREAU 4551 A, 4554 (AWAS)—det. HALE, 1965; on way to Pillar Rocks, near Golf Course, alt. 2250 m, on bark, AWASTHI & SINGH 70.187, 70.264 (LWU); Pillar Rocks, on bark, SINGH 70.647 (LWU); Bryant Park, on bark, SINGH 70.1055 (LWU); Observatory hill, on tree bark, SINGH 70.1155 (LWU); Shembaganur to Periakulam, alt. 1800 m, on bark, SINGH 70.897 (LWU). West Bengal—Darjeeling district, Botanic Garden, on tree trunk, AWASTHI 3832 (AWAS)—det. HALE, 1935; Tiger hill, alt. 2550 m, on bark, AWASTHI & AGARWAL 67.24 (LWU).

The taxon has also been reported from Darjeeling and E. Nepal by KUROKAWA (1966, p. 607).

21. *Parmelia flexilis* Kurok.

In Hara, *The Flora of Eastern Himalaya*, 607, 1966, Fig. 45.

Hypotrachyna flexilis (Kurok.) Hale, *Phytologia*, 28: 341, 1974.

Plate 7, Fig. 3

Thallus corticolous or saxicolous, foliose, loosely adnate to substratum, 4-6 cm in diameter, whitish grey to dark grey, irregularly sinuate lobate, lobes sublinear 3-5 mm wide, margin crenate, eciliate; upper surface smooth, dull; isidia and soredia absent; lower side black, densely rhizinate up to the margin, rhizinae dichotomously branched; medulla white. Apothecia numerous, adnate to substipitate, 2-3 mm in diameter, concave to plane; disc light brown; amphithecium smooth; hymenium 50-70 μ m high; asci rarely mature, 8 spored; spores colourless, simple, oval ellipsoid, 11-16 \times 6-11 μ m. KUROKAWA (l.c.) has given the spore size 15-21 \times 8-11 μ m.

Thallus K+yellow; medulla K—, C—, KC—, P—; atranorin and protolichesterinic acid present.

Parmelia flexilis shows some resemblance to *P. scytophylla* but is smaller in size of thallus, apothecia, and is chemically different. The taxon is known from eastern Asia and India.

Specimen examined:

West Bengal—Darjeeling district, Kurseong, alt. 1500 m, over boulder, AWASTHI & AGARWAL 66.333 pr. p. (LWU); Bot. Garden Darjeeling, alt. 1950 m, on twigs of shrubs, AWASTHI 3835 (AWAS)—det. KUROKAWA.

The taxon has also been reported from Darjeeling by KUROKAWA (1966, p. 607) and the type specimen is from Senchal, Darjeeling.

22. *Parmelia formosana* Zahlbr.

Fedde Rept. Sp. nov. 33: 57, 1933; Lamb, *Index. Nom. Lich.* 476, 1963.

Hypotrachyna formosana (Zahlbr.) Hale, *Smithsonian Contr. Bot.* No. 25: 38, 1975.

Plate 6, Fig. 4

Thallus corticolous, foliose, closely adnate to substratum, 4-8 (10) cm in diameter, glaucous grey to dark grey, subdichotomously to irregularly sinuate lobate; lobes sublinear, contiguous, \pm uniform in width, 1-3 mm wide, discrete, apices rounded to retuse; margin eciliate; upper surface smooth, dull, emaculate, plane to slightly convex, pustulate, pustules breaking apically and producing granular sorediate structures, sometimes soralia crateriform, with granular dense soredia and pustules indistinct; lower side black, densely rhizinate up to the margin; rhizinae often projecting beyond the lobe margins, dichoto-

mously copiously branched; medulla white to ochraceous pigmented, pigment distinct near the soralia. Apothecia rare, 2-4 mm in diameter, substipitate, concave; margin crenate, inflexed; disc brown; amphithecium smooth, to pustulate sorediate; hymenium 35-50 μ m high; asci 8 spored; spores colourless, simple, ellipsoid, 7-14 \times 5-8 μ m. Thallus K+ yellow; medulla white K—, pigmented region K+ purple, C—, KC+ red, P—.

Parmelia formosana externally closely resembles *P. texana*, but the latter species has white medulla and the rhizinae are simple.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Meghalaya—Shillong, near Shillong Peak, alt. 1900 m, on bark of tree, AWASTHI 7867 (AWAS); Shillong to Jowai route, on Pine tree, AWASTHI 8011 A (AWAS). Tamil Nadu—Nilgiri hills, Kodanad, near Forest Rest House, on bark, AWASTHI & SINGH 70.1398 (LWU); Kotagiri to Kodanad route, near Finger Post, on bark, SINGH 71.921 (LWU)—fertile; Sholurmatta, near Kilkotagiri, alt. 1600 m, on bark, SINGH 71.912 (LWU); Palni hills, Kodaikanal, alt. 2100 m, on bark, HÖEG 2524, 2525, 2526 (AWAS)—det. Kurokawa; around lake, alt. 1900 m, SINGH 70.772 A (LWU)—fertile; Golf Club area, on bark, SINGH 70.640 (LWU); on trunk of Pine, DEGELIUS As—269 (DEGELI); Moir Point, on Rhododendron bark, DEGELIUS As—274 pr. p. (DEGELI)—det. HALE; Bryant Park, on bark, SINGH 70.1049 (LWU)—fertile; Pillar Rocks area, on Rhododendron bark, AWASTHI & SINGH 70.202 (LWU); 70.219 (LWU)—fertile; SINGH 70.667, 70.745 (LWU)—fertile; Kodaikanal to Berijam route, FOREAU 4138 (AWAS)—det. HALE, 1965; Kodaikanal to Pambampuram route, on bark, SINGH 70.587 pr. p. (LWU); Oothu area, on bark, AWASTHI & SINGH 70.403 (LWU)—fertile; Perumal Coffee Plantation, alt. 1500 m, on bark, SINGH 70.1113 (LWU); Sirudamkanal Shola, alt. 1900 m, on bark, FOREAU 4551 C (AWAS)—det. HALE. West Bengal—Darjeeling district, Observatory Hill, alt. 2100 m, on *Cryptomeria* bark, AWASTHI 3872 (AWAS)—det. HALE; Kurseong, Dow Hill, on bark, AWASTHI & AGARWAL, 66.186, 66.258 (fertile) (LWU); Darjeeling, Bot. Garden, on bark, AWASTHI 3831 (AWAS)—fertile, det. Kurokawa; Kalimpong division, Munsong, on bark, AWASTHI & AGARWAL, 67.272 (LWU).

The taxon has been reported from Darjeeling by KUROKAWA (1966, p. 607) as well.

23. ***Parmelia halei*** Awasthi sp. nov.

Plate 3, Fig. 6

Thallus corticola, adnatus, 4-8 cm diametro, cincrascens, irregulariter lobatus, lobis imbricatis, sublinearis, 1—4 (6) mm latis, margine ciliatis, superne laevigatus, emaculatus, isidiatus, isidiis simplices vel coralloideo-ramosis, subtus niger, rhizinosus, rhizinis simplices, ambitu anguste castaneus, nudus; medulla albidoflavescens. Apothecia ignota.

Thallus corticolous, foliose, closely adnate to substratum, 4-8 cm in diameter, ashy grey to dark grey, irregularly densely lobate, lobes much imbricated, \pm convolute, 1-4 (6) mm wide, sublinear; margin ciliate; cilia simple; upper surface emaculate, smooth, dull in submarginal region, inwards densely isidiate, isidia cylindrical, simple to coralloid branched, 0.5-1 mm long; lower side black, densely rhizinate, marginal zone dark brown, erhizinate, \pm shining, rhizinae simple; medulla white to yellowish. Apothecia absent.

Thallus K+ yellow; medulla K+ yellow, C—, KC—, P+ orange in upper part and deep yellow in lower part; atranorin and stictic acid present.

Parmelia halei has been named after Dr. Mason E. Hale, Jr. who has contributed much towards the monographic revisions of the genus. The specimen packet had been examined by him and indicated that it is 'probably a new species'. The taxon is quite unique in possessing stictic acid with isidia and simple cilia. Only one species—*P. internexa* Nyl.—is known to have stictic acid in this group, and that species has large (24-34 μ m long) spores and is known from Brazil.

Holotype—India, Uttar Pradesh, Dehradun District, Mussoorie, alt. ca 2000 m, on bark of conifer tree, July 7, 1957, D. D. AWASTHI 3800 (AWAS).

24. ***Parmelia homogenes* Nyl.**

Flora, 68: 607, 1885; *Zahlbr. Cat. Lich. Univ.* 6: 168, 1930.

Parmelina homogenes (Nyl.) Hale, *Phytologia*, 28: 482, 1974.

Plate 5, Fig. 4

Thallus corticolous, foliose, loosely adnate to substratum, 4-6 cm in diameter, mineral grey to grey and darker in the central region, irregularly sinuate lobate; lobes sublinear, 3-5 mm wide, \pm imbricate, apically truncate, margin ciliate in axils; upper surface smooth, dull, plane to rugose in the central part, faintly maculate in young lobes; isidia and soredia absent; lower side black, sparsely to densely rhizinate up to the margin; rhizinae simple, sometimes apically forked to squarrosely branched; medulla yellow. Apothecia numerous, adnate to substipitate, imperforate, 3-5 mm in diameter; margin crenate to minutely lobulate and inflexed; disc dark brown, smooth; hymenium 50-70 μ m high; spores colourless, simple, $11-18 \times 6-9 \mu$ m.

Thallus K+ yellow; medulla K—, C—, KC—, P— or + faintly yellow, only atranorin found in crystal tests, though zeorin and entothecin are reported in the taxon.

Parmelia homogenes closely resembles *P. subaurulenta* differing only in the larger size of the spores. The taxon is mostly distributed in temperate Asia.

Specimen examined:

Tamil Nadu—Palni hills, Kodaikanl, alt. 2100 m, on bark of tree, SINGH 70.506 (LWU).

Extra-Indian specimens examined:

Nepal—E. Nepal, Dhankuta province, alt. 1680 m, on tree bark, NORKETT 6775 (BM)—det. HALE, 1967; Taplejung district, Milke Dandra forest, alt. 2550 m, on bark of tree, NORKETT 7072 (BM); ascent to Sandakhpoo (India) from Nepal side, alt. 3000 m, on dead wood stump, AWASTHI 2457 (AWAS).

25. ***Parmelia imbricatula* Zahlbr.**

Denks. Akad. Wiss. Wien, Math. Nat. Kl. 83: 168, 1909, tab. 1, fig. 2; *Cat. Lich. Univ.* 6:169, 1930.

Hypotrachyna imbricatula (Zahlbr.) Hale, *Smithsonian Contr. Bot.* No. 25:41, 1975.

Thallus corticolous, foliose, loosely to closely adnate to substratum, 3-7 cm in diameter, yellowish grey, mineral grey to darkish grey, irregularly lobate; lobes sublinear, (1) 2-5 mm wide, often much crowded, apices rounded to truncate, sometimes lobes longitudinally convolute; margin somewhat undulate, crenate, eciliate; upper surface smooth, \pm shining at periphery, minutely subdistinctly maculate, sparsely to densely isidiate; isidia simple, filiform to branched; lower side black, densely rhizinate; rhizinae often projecting beyond the margin of the lobes, densely dichotomously branched, sometimes marginal zone with rhizinal papillae; medulla white. Apothecia usually present, substipitate, 1-2 mm in diameter, concave; disc light brown; amphithecium smooth, non-isidiate; hymenium 60-90 μ m high; asci 8 spored; spores colourless, simple, $8-13 \times 5-7 \mu$ m.

Thallus K+yellow; medulla K—, C—, KC+rose or red, P—; atranorin and barbatic acid present. HALE (l.c.) has also reported the presence of 4-O-demethylbarbatic acid, obtusatic acid and norobtusatic acid, the presence of which can only be demonstrated by T.L.C.

Parmelia imbricatula shows a close similarity to *P. orientalis*, the difference being the absence of obtusatic and norobtusatic acids in the latter. *P. orientalis*, thus, is only a chemical species as no distinct morphological differences are noticeable; the only difference is somewhat larger, broader lobes in *P. imbricatula*.

Specimens examined:

Meghalaya—Shillong, near Elephant Falls, alt. ca. 1500 m, on bark of Pine tree, AWASTHI 7896 (AWAS)—fertile; Shillong to Jawai road, near Thadlaskein Lake, alt. 1000 m, on bark of Pine tree, AWASTHI

8024 (AWAS)—fertile; Tamil Nadu—Palni hills, Kodaikanal to Berijam road, at 14th Km, alt. 2250 m, on branches of tree, FOREAU & AWASTHI 4235 A (AWAS)—fertile, det. HALE, 1965; Kodaikanal, near Moir Point, alt. 2100 m, on bark of *Rhododendron arboreum*, DEGELIUS As—274 pr. p. (DEGEL)—det. HALE; Sirudumkanal Shola, alt. 1850 m, FOREAU 4661 B (AWAS)—det. HALE, 1965.

26. *Parmelia incognita* Kurok.

In HARA, *The Flora of Eastern Himalaya*, 608, 1966.

Hypotrachyna incognita (Kurok.) Hale, *Phytologia*, 28: 341, 1974.

Parmelia koyaensis f. *inactive* Asah. *J. Jap. Bot.* 28:68, 1953, pr. p.

The taxon has been reported from Batasi, Darjeeling district, by KUROKAWA (1966). We have not been able to collect any specimen to conform to the description of this taxon, and the following description is therefore given as ready reference and is based on the observations by KUROKAWA.

Thallus 4-5 cm in size, lobes \pm imbricate, 3-5 mm wide, crenate, grey, upper surface smooth, isidiate. Thallus K + yellow, medulla K—, C + rose, KC + red, P—; atranorin, gyrophoric acid and protolichesterinic acid present.

The taxon apparently shows some similarity to *P. neodissecta* but is different chemically.

27. *Parmelia infirma* Kurok.

In HALE and KUROKAWA, *Contr. U. S. Nat. Herb.* 36: 179, 1964, pl. 7, fig. 4.

Hypotrachyna infirma (Kurok.) Hale, *Phytologia*, 28: 341, 1974.

Plate 6, Fig. 3

Thallus corticolous, rarely saxicolous (?), foliose, closely to loosely adnate to substratum, 4-8 cm in diameter, glaucous grey to grey, irregularly sinuate lobate, lobes sub-linear, 1-3 mm wide at the margins, centrally up to 10 mm wide, irregularly dentate, lobes sometimes imbricate, margin black rimmed, eciliate; upper surface dull, emaculate, smooth, isidiate; isidia cylindrical, filiform, solid, uniformly thick or irregular in thickness, somewhat thinner than *P. koyaensis*, simple to branched; lower side black, marginal area dark brown to brown black, shining; rhizinae sparse to absent in the marginal area, centrally moderately present, dichotomously once or twice furcate; medulla white. Apothecia adnate to substipitate, 1-2 mm in diameter; margin entire, inflexed; amphithecium often isidiate; disc dark brown to brown black; hymenium 65-85 μ m high; asci 8 spored; spores colourless, oval, 15-19 \times 9-11 μ m.

Thallus K + yellow; medulla K—, C—, KC—, P—; (atranorin, protolichesterinic acid and caperatic acid are reported).

Parmelia infirma is based on a collection from Darjeeling, and is distinguished by the negative reactions in medulla by the usual chemicals. It has been found distributed in Japan, Formosa, Thailand, and Indonesia.

Specimens examined:

Meghalaya—Shillong to Jowai route, near Thadlaskein Lake, alt. 1000 m, on bark of Pine tree, AWASTHI 8027 A (AWAS)—sterile. Tamil Nadu—Kodaikanal in Palni hills, near La Providence, alt. 2100 m, on tree trunk, DEGELIUS As—234 (DEGEL)—det. HALE. West Bengal—Darjeeling district, Kurseong, Dow Hill, alt. 1800 m, on tree trunk, AWASTHI & AGARWAL 66.210, 66.250, 66.261 (LWU); Kalimpong to Munsong, alt. 1500 m, on bark of trees (conifer and others), AWASTHI & AGARWAL 67.231 A, 67.253, 67.312 (LWU)—first two fertile, third sterile; Tiger Hill, alt. 2100 m, AWASTHI (AWAS)—fertile; on twigs of shrubs, AWASTHI & AGARWAL 67.37, 67.54 (LWU)—fertile. Also reported from Darjeeling by KUROKAWA (1966, p. 609).

Extra-Indian specimens examined:

Nepal—No precise locality, BANERJEE 1413 (AWAS)—fertile, det. Kurokawa; E. Nepal, near Taplejung, alt. 1500 m, over stone (?) AWASTHI 2482 (AWAS)—det. HALE.

28. *Parmelia isidiza* Nyl.

Bull. Soc. Bot. 3: 130, 1884 & *Flora*, 68: 612, 1885; *Zahlbr. Cat. Lich. Univ.* 6: 170, 1930.

Bulbothrix isidiza (Nyl.) Hale, *Phytologia*, 28: 480, 1974.

Plate 2, Fig. 3.

Thallus corticolous, rarely terricolous, foliose, loosely to closely adnate to substratum, 5-8 cm in diameter, mineral grey, dark grey to light brownish, irregularly sinuate lobate; lobes linear, 2-6 (10) mm wide, rounded or truncate at the apices; margin with sparse or dense bulbate cilia; cilia 0.5-0.75 mm long; upper surface plane, dull, smooth, emaculate, densely isidiate; isidia cylindrical, simple, black tipped and eventually coralloid branched; lower side pale grey to pale brown, smooth with uniformly distributed short, simple, brown-black rhizinae, the marginal zone dark brown with rhizinal papillae and some what shining. Thallus 150-200 μ m thick; medulla white to yellowish (apparently due to degradation of salacinic acid). Apothecia usually present, 2-4 (10) mm in diameter, adnate, imperforate; disc dark brown; margin inflexed; amphithecium smooth to isidiate; spores colourless, simple, oval ellipsoid, 9-12 (19) \times 6-8 (10) μ m. (NYLANDER: in type specimen 9-12 \times 6-8 μ m.)

Thallus K+ yellow; medulla K+ yellow turning red, C—, P+orange red; atranorin and salacinic acid present.

Parmelia isidiza is the only Indian species with isidia and bulbate cilia, and is widely distributed in the country.

Specimens examined:

Meghalaya—Shillong, near Mawlai Pine forest, alt. 1500 m, over hard soil, AWASTHI 7906 B (AWAS)—sterile; Jowai route from Shillong, near Thadlaskein Lake, alt. 1000 m. on tree twigs, AWASTHI 8026 (AWAS). Uttar Pradesh—Nainital district, Kali river valley near Tanakpur, on tree trunk, AWASTHI 3178 (AWAS); Pithoragarh district, Askote, alt. 4500 m, on tree trunk, AWASTHI 2657 (AWAS)—sterile, det. HALE; AWASTHI 6408 (sterile), 6417 (fertile) (AWAS). West Bengal—Darjeeling district, near Chunabhatti, alt. 600 m, on tree trunk, AWASTHI & AGARWAL 66.105 (LWU)—sterile; Kurseong, alt. 1650 m, on tree, AWASTHI & AGARWAL 66.170 (LWU)—sterile; Kalimpong, Munsong, alt. 1500 m, on *Alnus* bark, AWASTHI & AGARWAL 67.302 (LWU)—fertile; on *Cinchona* bark, AWASTHI & AGARWAL 67.287 A (LWU)—fertile; Jalpaiguri district, Oodlabari-Manabari tea estate, alt. 300 m, on *Albizia* tree trunk, AWASTHI & AGARWAL 66.39 (LWU)—sterile.

Taxon reported from Darjeeling, Takdah, by KUROKAWA (1966, p. 609).

Extra-Indian specimen examined:

Nepal—E. Nepal, Phidim, alt. 900 m, over stone with soil, AWASTHI 2178 (AWAS)—fertile, det. HALE, 1967. Taxon also reported from E. Nepal by KUROKAWA (1967, p. 95).

29. *Parmelia koyaensis* Asah.

J. Jap. Bot. 28:67, 1953, cum icon; Lamb, *Index Nom. Lich.* 483, 1963.

Hypotrachyna koyaensis (Asah.) Hale, *Smithsonian Contr. Bot.* No. 25:44, 1975.

Plate 6, Fig. 1

Thallus corticolous, rarely saxicolous or terricolous, foliose, loosely adnate to substratum, 6-8 cm in diameter, irregularly sinuate lobate, mineral grey to grey; lobes 4-8 mm wide, imbricate, sublinear; margin undulate, eciliate, crenate to incised and minutely lobulate; upper surface smooth, dull, emaculate, isidiate; isidia sparse, globular to cylindrical filiform to irregularly thickened, simple to branched and solid; lower side black, shining or dull, sparsely or moderately rhizinate, marginal 1 mm wide zone sometimes dark brown, erhizinate or with rhizinal papillae; rhizinae simple to dichotomously branched, short, furcate only once; medulla white. Apothecia usually present, adnate, constricted at base, 1-2 (3) mm in diameter; margin entire to crenate, inflexed; disc dark-brown, plane;

amphithecium often isidiate; hymenium 75-100 μm high; asci 8 spored, 65-80 \times 25-30 μm in size; spores colourless, simple, oval ellipsoid, 18-26 \times (7) 10-13 (15) μm .

Thallus K+yellow; medulla K—, C—, KC—, P+ orange red; atranorin and protocetraric acid present (an unidentified fatty acid has also been reported).

Parmelia koyaensis shows similarity to *P. incognita* and *P. neodissecta* in general habit of thallus, but from both of them it differs in the medulla C—reaction. The taxon is distributed in eastern Asia and Himalayas.

Specimens examined:

Sikkim—J. D. HOOKER 2003 pr. p. (BM). Tamil Nadu—Nilgiri hills, Naduvattam Cinchona Plantation, on bark of Cinchona tree. SINGH 72.73, 72.95 (LWU)—fertile; Uttar Pradesh—Almora district, below Loharkhet, alt. 1500 m, on tree trunk, AWASTHI 7528 (AWAS)—sterile. West Bengal—Darjeeling district, above Kurseong, alt. 1650 m, on tree trunk, AWASTHI 3924 (AWAS)—fertile, det. Hale, 1967; Dow hill, on tree trunk, AWASTHI & AGARWAL 66.265, 66.263 (LWU)—fertile; towards Mahanadi, alt. 1200 m, on soil over boulder, AWASTHI & AGARWAL 66.292 (LWU)—sterile; Darjeeling, Pashok Road, alt. 1900 m, on tree trunk, AWASTHI & AGARWAL 67.149, (fertile), 67.166 (sterile) (LWU).

The taxon has also been reported from Darjeeling by KUROKAWA (1966, p. 609).

30. ***Parmelia malaccensis* Nyl.**

J. Linn. Soc. Bot. 20: 52, 1883; *Zahlbr. Cat. Lich. Univ.* 6:142, 1930.

Pseudoparmelia malaccensis (Nyl.) Hale, *Phytologia*, 29: 190, 1974.

Thallus corticolous, foliose, closely adnate to substratum, 4-5 cm in diameter, yellowish grey to pale grey, sinuate lacinate lobate, lobes linear, 0.5-2 mm wide, discrete to imbricate, plane to convex; margin eciliate; upper surface smooth to rugulose, dull to shining, isidiate; isidia globular to filiform, minute, 0.1 mm thick and 0.2 mm long, simple to rarely branched; lower side pale grey to brownish, rhizinate up to the margin; rhizinae simple, short, sparse; medulla white. Apothecia dense, numerous, 1-1.5 (2) mm in diameter, sessile to constricted at base; disc plane to convex, dark brown; margin thin,, minutely crenulate and inflexed; hymenium hyaline, 45-60 μm high; epithecium brownish; asci biserially 8 spored; spores colourless, simple, oval, 6-8 \times 4-5 μm , often with two oil globules; paraphyses ca. 3 μm thick.

Thallus K+ yellowish; medulla K—, C—, KC—, P+orange red; usnic acid and protocetraric acid present.

Parmelia malaccensis is distinguished by the narrow linear lacinae like lobes, which are isidiate, and medulla is P+orange red. The taxon is known from Malacca.

Specimen examined:

Kerala—(Travancore), Quilon, 1953, on bark of tree, HÖEG 2600 (AWAS)—det. HALE.

31. ***Parmelia marmariza* Nyl.**

Lich. Jap. 28, 1890; *Zahlbr. Cat. Lich. Univ.* 6: 175, 1930.

Thallus corticolous, foliose, loosely adnate to substratum, 3-4 cm across, dark ashy grey, irregularly lobate; lobes sublinear, short, up to 5 mm wide, imbricate and ascending; upper surface smooth, densely minutely white maculate, maculae not raised above the general surface, becoming pseudocyphelette in older lobes; isidia and soredia absent; lower side black, densely rhizinate up to the margin, rhizinae simple to furcate. Thallus ca. 200 μm thick; upper cortex discontinuous, interrupted by loose hyphae with no algal cells in the region; medulla white. Apothecia substipitate, 4-6 mm in diameter; disc dark brown; amphithecium white maculate; hymenium 80 μm high, asci 60 \times 20-25 μm , 8 spored; spores colourless, simple, oval ellipsoid, 14-20 \times 8-10 μm , (NYLANDER gave the dimension of spores 11-14 \times 7-8 μm).

Thallus K+yellow; medulla K+yellow turning red, C—, P+orange red; atranorin and salacinic acid present.

Parmelia marmariza is characterized by dense minute maculations which become pseudocyphellate later. The taxon is closely related to *P. adaugescens*, but is distinguished by unraised maculae and smaller spores. NYLANDER had mentioned the spore size smaller than what we have found in our specimen. The taxon is known from eastern Asia.

Specimen examined:

Uttar Pradesh—Almora district, Dhakuri ridge, on way to Pindari Glacier, alt. 2850 m, on tree trunk, AWASTHI & AWASTHI 644 (AWAS)—determination approved by HALE.

32. ***Parmelia massartii* Hue.**

Ann. Jardin Bot. Buitenzorg, 17: 176, 1901; *Zahlbr. Cat. Lich. Univ.* 6: 175, 1930.

Hypotrachyna massartii (Hue) Hale, *Phytologia*, 28: 341, 1974.

Plate 6, Fig. 6

Thallus corticolous, loosely adnate to substratum, 6-8 cm in diameter, mineral grey to grey, subdichotomously to irregularly sinuate lobate, lobes sublinear, truncate, 6-10 mm wide, margin eciliate; upper surface smooth, emaculate; isidia and soredia absent; lower side black, rhizinate up to the margin; rhizinae densely dichotomously branched and projecting beyond the lobe margins; thallus 200-210 μ m thick; medulla white. Apothecia substipitate, up to 5 mm in diameter; disc brown; amphithecium smooth; hymenium 45-55 μ m high; asci 8 spored; spores colourless, simple, oval to ellipsoid, 12-17 \times 6-9 μ m.

Thallus K+yellow; medulla K—, C—, KC+ orange, P—; atranorin and barbatic acid present.

Parmelia massartii shows resemblance to *P. bostrychodes* in the nature of lobes, size of spores, and presence of barbatic acid, but differs in the amphithecium being rugose. The taxon is known from Eastern Asia.

Specimens examined:

Arunachal Pradesh—(N.E.F.A.) Chakoo and Parila, alt. 2750 m, on twigs, PANIGRAHI 6350B, 6395 (AWAS). Manipal—No precise locality, WATT 6950 (BM). Sikkim—alt. 2100m, HOOKER 1918 (BM). Tamil Nadu—Nilgiri hills, Nilgiri Peak, Carriat Shola, alt. 2250 m, on bark of tree, SINGH 72.25 (LWU). West Bengal—Darjeeling district, Tiger hill, alt. 2500 m, BOSE 60.15 (AWAS); Tonglloo, alt. 2700 m, on twigs, Watt sine Number (BM); alt. 3000 m, WATT 7042 (BM).

33. ***Parmelia meiophora* Nyl.**

Lich. Insul. Guineens. 45, 1889; *Zahlbr. Cat. Lich. Univ.* 6: 175, 1930.

Plate 1, Fig. 2

Thallus corticolous, rarely saxicolous, foliose, thick coriaceous, closely to loosely adnate to substratum, 8-10 cm in diameter, mineral grey to grey, irregularly sinuate lobate; lobes±convoluted, much imbricate, 2-5 mm wide, margin crenate, eciliate; upper surface densely white maculate and minutely (discernible only under lens) pseudocyphellate, pseudocyphellae irregular in outline; cortex often cracked in older parts; isidia present in older part of the lobes, laminal, globular to slightly elongated, simple; lowerside black, densely rhizinate up to the margin; rhizinae black, densely squarrose branched; medulla white. Apothecia absent in specimens examined.

Thallus K+ yellow; medulla K+yellow turning red, C—, P+ orange red; atranorin and salacinic acid present.

Parmelia meioophora is distinctive in being densely maculate and minutely pseudocyphellate and isidiate. The specimens of this taxon may sometimes be confused with those of *P. wallichiana* if due attention to the presence of maculae and pseudocyphellae is not given. The taxon had been described from Yunnan, China.

Specimens examined:

Himachal Pradesh—Manali, alt. 1800 m, on bark of *Cedrus deodara*, AWASTHI & DANGE 75.024 (LWU); Parbati river valley, Pulga, on bark of conifer tree, alt. 2340 m, AWASTHI & DANGE 75.175 (LWU); Bhandathaj, above Pulga, alt. 3150 m, on bark of Conifer tree, AWASTHI & DANGE 75.255, 75.258 (LWU); alt. 3300 m, over rock AWASTHI & DANGE 75.363 (LWU).

34. ***Parmelia meizospora*** (Nyl.) Nyl.

Flora, 52: 292, 1869; Zahlbr. *Cat. Lich. Univ.* 6: 175, 1930.

Parmelia tiliacea var. *meizospora* Nyl. *Synop. Lich.* 1: 382, 1860.

Bulbothrix meizospora (Nyl.) Hale, *Phytologia*, 28: 480, 1974.

Plate 2, Fig. 6

Thallus generally corticolous, rarely saxicolous or terricolous, foliose, thick coriaceous, closely adnate to substratum, 8-12 cm in diameter, ashy grey to bluish dark grey, subdichotomously lobate; lobes irregular, imbricate, 5-8 mm wide; margin dentate, bulbate ciliate; bulbate cilia mostly at the notches, 0.2-0.75 mm long; upper surface smooth to often longitudinally wrinkled-rugulose, marginal area brown black punctate due to pycnidia; isidia and soredia absent; lower side black, densely rhizinate, a narrow marginal zone with rhizinal papillae and \pm shining; rhizinae simple, black. Thallus 300-350 μ m thick, medulla white (or yellowish ochraceous due to decomposition of salacinic acid). Apothecia numerous, substipitate, 6-10 mm in diameter, imperforate; disc concave, brown; margin inflexed; amphithecium smooth to rugose; hymenium 80-100 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid or ovoid, $12-20 \times (6) 8-12 \mu$ m.

Thallus K+ yellow; medulla K+ yellow turning red, C—, P+orange red; atranorin and salacinic acid present.

Parmelia meizospora shows a close external resemblance to *P. setschwanensis*, the latter being distinguished by a pale brown lower surface. The medulla in *P. meizospora* is often observed to be yellow-ochraceous, which is apparently due to the decomposition of the salacinic acid present in the medulla. This colorization is shared by several species of *Parmelia* that contain salacinic acid. The bulbate cilia sometimes tend to be indistinct, but they are often more easily seen in the notches of the margin. The species is widely distributed in the Himalayan region.

Specimens examined:

Meghalaya—No precise locality, BHATT 3339 (AWAS)—vidi HALE, 1967. Sikkim—Near Gangtok, on tree bark, AWASTHI 27 (AWAS). Tamil Nadu—Palni hills, Kodaikanal, Pillar Rocks area, alt. 2250 m, on tree, SINGH 70.66 (LWU); on way to Kuranjiandvar temple, alt. 1800 m, on tree, SINGH 70.1302, 70.1305 (LWU); Shembaganur, alt. 1800 m, on peach tree, SINGH 70.861 (LWU). Uttar Pradesh—Almora district, Almora, on *Aesculus* bark, alt. 1600 m, PANT 459, 460 (AWAS); Kasardevi, alt. 1800 m, on Pine trunk, and *Aesculus* tree trunk, AWASTHI 3443, 3447 (AWAS); Kausani, alt. 1800 m, on Pine tree trunk, SEN 3171 (AWAS); Loharkhet, alt. 1600 m, on bark and rocks, Awasthi 7529, 7533 (AWAS); Takula, AWASTHI & AWASTHI 575 (AWAS); Ranikhet to Chaubattia, AWASTHI 3543 (AWAS)—vidi HALE; AWASTHI & DANGE 74.94 (LWU); Dehradun district; Chakrata, alt. 2100 m, on bark of *Quercus* tree, AWASTHI 464, 474, 477 (AWAS); alt. 1800 m, on *Quercus* tree, AWASTHI & JOSHI 76.21, 76.30, (LWU); Mussoorie, alt. 1800—2000 m, on bark and over rocks, HÖEG 1437, 1451, 1441, 3390, 3403 (AWAS); AWASTHI 3798, 3799 (AWAS); Joshi 75.007, 75.037, 75.099, 75.166, 75.181, 75.192, 75.287, 75.246 (LWU); Comm. SESHADRI 3393 (AWAS); Nainital district, SHARMA 3336 (AWAS), comm. SESHADRI 3605 (AWAS); Naini Tal, near Snow view and Tiffin top, alt. 2250 m,

AWASTHI & DANGE 74.4, 74.6, 74.75 (LWU); Pithoragarh district, Askote, over stones, AWASTHI 9 (AWAS); on bark of tree mostly on *Quercus*, AWASTHI 412, 2683, 3291 A (AWAS)—det. HALE; Uttarakshi district, above Gangrani, towards Jamaotri, alt. 1500 m, over rocks, AWASTHI 897 (AWAS). West Bengal—Darjeeling district, Ghunabhatti to Tindharia, alt. 750 m, on bark, AWASTHI & AGARWAL 66.129 (LWU); Batasi, alt. 1900 m, over stone, AWASTHI 14 (AWAS); Kalimpong, near Munsong, on *Cinchona* bark, AWASTHI & AGARWAL 67.293, 67.304 A (LWU); Kurseong, alt. 1500 m, on bark, AWASTHI & AGARWAL 66.338 (pr. p.), 66.339 (LWU). The taxon has been reported from Darjeeling and Sikkim by KUROKAWA (1966, p. 609).

Extra-Indian specimen examined:

Nepal—No precise loc. 1952, BANERJEE 1403 (AWAS)—det. HALE;

35. ***Parmelia microlobulata*** Awasthi sp. nov.

Plate 8, Figs. 4 & 5

Thallus corticolous, adnatus, usque 3 cm diametro, pallido-cinereus, irregulariter lobulatis, lobis sub-linearibus, 0.25-1 mm latis, margine dissectis, sparse ciliatis; superne emaculatis, isidiato-lobulatis, lobulis dorsiventralibus irregulariter lobulis, apice acutis, subtus niger, rhizinosus, ambitu castaneus; rhizinis nigris simplicibus. Apothecia ignota.

Thallus corticolous, foliose, closely adnate to substratum, up to 3 cm in diameter, pale grey to ashy grey, irregularly lobate, lobes short, sublinear, 0.25-1 mm wide, dissected crenate at apices, margin dark brown rimmed, sparsely ciliate; upper surface smooth, isidioid lobulate, isidia initially rounded, then cylindrical and ultimately flattened, dorsiventral lobulate with brown margin and sometimes marginally ciliate resembling the minute lobules of the thallus; lower side black, marginal narrow zone dark brown, sparsely rhizinate; rhizinae short (0.2-0.5 mm long) simple; medulla white. Apothecia not known.

Thallus K—; medulla K—, C—, KC—, P—; atranorin, and protolichesterinic type of crystals formed in G.E.

Parmelia microlobulata is distinctive in the minute lobes, isidioid-lobules irregular in outline and medulla negative to chemical reactions. It shows some similarity to *Parmelia spatulata* Kurok. in the isidioid-lobules, but in that species the lobules are dilated towards the apices and the medulla has gyrophoric acid (C+rose, KC+ red).

Holotype—India, West Bengal, Darjeeling district, between Chunarhatti and Tindharia, alt. ca. 750 m, on bark of tree, Feb. 21, 1966, D. D. AWASTHI & M. R. AGARWAL 66.120 (LWU).

36. ***Parmelia mulleri*** Vain.

Étud. Lich. Brésil. 1:49, 1880; *Zahlbr. Cat. Lich. Univ.* 6: 176, 1930.

Parmelina muelleri (Vain.) Hale, *Phytologia*, 28:483, 1974.

Plate 3, Fig. 3

Thallus corticolous, foliose, closely adnate to substratum, 6-8 cm in diameter, mineral grey to ashy grey, irregularly compactly lobate; lobes subrotund, 2-5 mm wide, complicate, incised crenate to dentate, margin sparsely ciliate; cilia simple; upper surface smooth, dull, emaculate, submarginally indistinctly pustulate, pustules soon sorediate; soralia globular to ovoid, up to 2.5 mm in diameter; soredia farinose; lower side black, moderately rhizinate; rhizinae up to the margin, simple or rarely squarrosely branched; medulla white. Apothecia absent in the specimen examined.

Thallus K+ yellow; medulla K—, C—, KC—, P—; only atranorin present.

Parmelia mülleri externally somewhat resembles *P. aurulenta* but differs in the smaller sized thallus, and white medulla. The taxon is known from S. America.

Specimen examined:

Himachal Pradesh—Parbati river valley, on way to Pulga from Manikaran, alt. ca. 1950m, on bark of tree, AWASTHI & DANGE 75.092 (LWU).

37. **Parmelia neodissecta** Hale

Phytologia, 22:94, 1971.

Hypotrachyna neodissecta (Hale) Hale, *Smithsonian Contr. Bot.* No. 25-49, 1975.

Thallus corticolous, foliose, loosely attached or adnate to substratum, up to 5 cm in diameter, ashy grey to grey, irregularly lobate, lobes sublinear, 1-5 mm wide; margin crenate, eciliate; upper surface dull to shining at marginal area, and with minute punctate dots, inwards densely isidiate; isidia cylindrical, uniform to irregularly thickened, with lateral cactus like branches; lower side black, densely rhizinate; rhizinae moderately dichotomously branched; medulla white. Apothecia substipitate, 1-2 mm in diameter; disc dark brown; amphithecium smooth, much incurved at marginal area making the rim look much prominent and thick; asci not mature in specimen examined.

Thallus K+ yellow; medulla K—, C+ rose, KC+ red, P—; atranorin and gyrophoric acid present.

Parmelia neodissecta externally closely resembles *P. imbricatula* and *P. koyaensis* but is chemically different in medulla C+ rose KC+ red (due to presence of gyrophoric acid.) The taxon is distributed in Africa, America and in India.

Specimen examined:

West Bengal—Darjeeling district, Tiger Hill, alt. 2500 m, on twigs of shrub, AWASTHI 3886 (AWAS)—det. HALE.

38. **Parmelia nepalensis** Tayl.

London J. Bot. 6:172, 1847; *Zahlbr. Cat. Lich. Univ.* 6:59, 1930 sub *P. cirrhata* Fr.

Plate 3, Fig. 3

Thallus corticolous, saxicolous or terricolous, foliose, mostly suberect to pendulous, grey to dark grey, 4—10 cm in diameter, dichotomously laciniate lobate, lobes linear, elongate, much variable in width, usually 2—4 mm wide, apically tapering, thin to thick coriaceous; upper surface glaucous grey to dark grey, smooth, convex, margin black ciliate, cilia simple to branched; isidia and soredia absent; lower side black in the older part, pale brown to brown near the apices, concave canaliculate, often lacunose, rarely plane, moderately rhizinate to densely rhizinate; rhizinae simple, squarrosely branched to dichotomously branched; medulla white. Apothecia laminal, sessile to substipitate, 1—7 mm in diameter, entire to cracked lobulate; disc brown to dark brown; amphithecium smooth; asci 8 spored; spores colourless, simple, oval ellipsoid to sometimes reniform, (11) 15—22×5—9 μ m, epispore 1.5 μ m thick.

Thallus K+ yellow; medulla K+ red to brownish red, C—, P+ orange red; atranorin, salacinic acid and protolichesterinic acid present.

Parmelia nepalensis closely resembles *P. cirrhata* in all characters except in the presence of rhizinae on lower side. The taxon is widely distributed throughout the world, and in India it is one of the very common and widely distributed species of foliose lichens in the subtropical to temperate regions. The specimens exhibit a great deal of variation in the nature of thallus, thickness of laciniae, presence and size of apothecia and sometimes the lobes may be adnate to substratum.

Specimens examined:

Arunachal Pradesh—(N.E.F.A.); Chakoo, alt. 2400 m, PANIGRAHI 6350 (AWAS); Parila, alt. 2700 m, PANIGRAHI 6397 (AWAS); Jabrang to Thengri, alt. 1800 m, PANIGRAHI 6494 (AWAS); Baha, on shrubs, PANIGRAHI 15262 (AWAS); Bomdila alt. 2500 m, ROLLA RAO 7355 (AWAS); Nyukmadong, alt. 2300 m, on trees and shrubs, ROLLA RAO 7612 (AWAS); Nyukmadong to Sengdzong, alt. 2700 m, ROLLA RAO 7638 (AWAS). ASSAM Kynshi to Markasa, on twigs, PANIGRAHI 16375 (AWAS). Himachal Pradesh—Simla, Jakhu top, alt.

2400 m, on *Cedrus deodara* tree, AWASTHI 1419 (AWAS); Dharamshala, Mcleod Ganj, SHARMA 4 (AWAS). Sikkim—Jongri, BOSE 6296, 6320, 6355 (AWAS); no precise loc. AWASTHI 17 (AWAS). Tamil Nadu—Nilgiri hills, Doddabetta, alt. 2400 m, AWASTHI & SINGH 71.95, 71.98, 71.105, 71.175 (LWU); Pykara forest range, alt. ca. 2100 m, AWASTHI & SINGH 71.203 (LWU); Avalanche alt. 2100 m, AWASTHI & SINGH 71.254 (LWU); Upper Bhowani road, SINGH 71.696, 71.697 (LWU); Ootacamund to Kotagiri road, SINGH 71.1056, 71.1038, 71.1099, 71.1122 (LWU); Ootacamund to Mysore Road, AWASTHI 4528 (AWAS); SINGH 71.1131 (LWU); Niduvattam, SINGH 72.102, 72.65, 72.89 (LWU); Palni hills, Kodaikanal, alt. 2100 m, HÖEG 2519 (AWAS); Pillar Rocks, AWASTHI & SINGH 70.263, 70.318 (LWU); Kodaikanal—Berijam road, FOREAU & AWASTHI 4234 (AWAS); Kodaikanal, SINGH 70.625, 70.697 (LWU). Uttar Pradesh—Almora district, Dhakuri to Khati, alt. 2000 m, AWASTHI 690, 7567, 7613 (AWAS); Dhakuri ridge, alt. 2800 m, on twigs of tree, AWASTHI & AWASTHI 634 (AWAS); Kausani, alt. 1800 m, on twigs, SEN 3169 (AWAS); Kasardevi, alt. 1800 m, on trunk of Pine tree, AWASTHI 3445 (AWAS); Ranikhet to Chaubattia, alt. 1900 m, on twigs of trees, AWASTHI 3565 (AWAS); AWASTHI & DANGE 74.95 (LWU); Dehradun district, Chakrata, Deoban, alt. 2800 m, AWASTHI, 962, 468 (AWAS); Mussoorie, HÖEG 1144 (AWAS); AWASTHI 3802 (AWAS); Pithoragarh district, Askote, AWASTHI, 3993, 3999 (AWAS); Berinag, A. M. AWASTHI 452 (AWAS); Uttarkashi district, AWASTHI 977 (AWAS); Gwaldom, SWAMI PARANAVANAND 4025 (AWAS); Dehradun district, Mussoorie, Joshi 75.020 (LWU); 75.059, 75.222, 75.254 (LWU). West Bengal—Darjeeling, alt. 1800 m, AWASTHI 18, 21, (AWAS); B.T. 31.131, AWASTHI 3333 (AWAS); Kurseong, AWASTHI 3920 (AWAS); Tiger hill, on twigs, AWASTHI (AWAS); BOSE (AWAS); Kurseong, AWASTHI & AGRAWAL, on twigs, 66.154 (LWU); Kalimpong division, Munsong road, AWASTHI & AGARWAL, 67.277, 67.323 (LWU); Pashok road, alt. 1900 m, AWASTHI & AGARWAL 67.92, 67.177 (LWU); Tonglloo, alt. 3300 m, on twigs, AWASTHI & AGARWAL 67.534 (LWU); Sandakhpoo alt. 3600 m, on trees, AWASTHI & AGARWAL 67.397, 67.451, 67.520, 67.398, 67.457, 67.450, 67.430 (LWU).

Extra-Indian specimens examined:

Nepal—BANERJEE 1399 (AWAS); near Debuche, ROLLA RAO 13835 (AWAS); near Nigala, ROLLA RAO 13561 (AWAS). Pakistan—Thandiani, alt. 2700 m, Mc Vean 60.3 (AWAS).

The taxon has been reported from Darjeeling, Sikkim, and Nepal by KUROKAWA (1966).

39. *Parmelia orientalis* Hale

Phytologia, 22:435, 1972.

Hypotrachyna orientalis (Hale) Hale, *Phytologia*, 28: 341, 1974.

Plate 6, Fig. 2

Thallus corticolous, rarely terricolous, foliose, closely adnate to substratum, 4-6 cm in diameter, rather thin, mineral grey to ashy grey, divaricately to irregularly sinuate lobate, lobes 1-3 mm wide, sublinear to linear, sometimes crenate at margins; upper surface smooth, shining to dull inwards, densely isidiate; isidia filiform, simple to coralloid branched; lower side black, densely rhizinate up to the margin; rhizinae short, dichotomously richly branched; medulla white. Apothecia numerous, substipitate, 2-3 mm in diameter, corcave; disc light brown; amphithecium smooth, minutely crenulate at margin, and isidiate; hymenium 45-55 μ m; asci 8 spored; spores colourless, simple, oval ellipsoid, 9-12 \times 4-6 μ m.

Thallus K+ yellow; medulla K—C, —, KC+ red, P—; atranorin and barbatic acid present, (HALE also reported the presence of 4-O-demethylbarbatic acid).

Parmelia orientalis is very close to *P. imbricatula* and difficult to distinguish except by T.L.C. as the difference lies in the presence of obtusatic and norobtusatic acid in *P. imbricatula*. Morphologically the lobes of *P. imbricatula* are slightly broader than *P. orientalis*.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Tamil Nadu—Nilgiri hills, Emerald Road, on way to Muthorai, over hard soil, SINGH 73.492 (LWU); Palni hills, Kodaikanal, alt. 2200 m, on bark, HALE 43699 (AWAS)—fertile, det. HALE; Ootacamund, Bandy Shola, alt. 2100 m, over boulders and gravelly ground, AWASTHI & SINGH 71.287 (LWU); on way Kilkotagiri to Konada, alt. 1800 m, on bark of tree, AWASTHI & SINGH 71.33 (LWU); Ootacamund, Doddabetta Peak, alt. 2550 m, on bark of tree, AWASTHI & SINGH 71.166 (LWU).

40. ***Parmelia perisidians* Nyl.**

Acta Soc. Sci. Fenn. 26(10): 6, 1900; *Zahlbr. Cat. Lich. Univ.* 6:183, 1930.

Parmelina perisidians (Nyl.) Hale, *Phytologia*, 28: 483, 1974.

The taxon is based on a collection from Sri Lanka (Ceylon) collected by ALMQUIST. We have not been able to collect specimens conforming to the description of the taxon, but KUROKAWA (1966, p. 609) has reported it from Pamianch, Sikkim, and thus it is likely to occur in other parts of India. The taxon is distinguished by the following characters.

Thallus foliose, corticolous, distinctly maculate, margin ciliate, isidia cylindrical, medulla yellow-ochraceous, K+deep yellow P—.

41. ***Parmelia physcioides* Nyl.**

Synop. Lich. 1:385, 1860; *Zahlbr. Cat. Lich. Univ.* 6:184, 1930.

Hypotrachyna physcioides (Nyl.) Hale, *Smithsonian Contr. Bot.* No. 25: 54, 1975.

Parmelia boliviana Nyl. *Flora*, 68: 612, 1885; *Zahlbr. Cat. Lich. Univ.* 6: 153, 1930.

The taxon has not been collected by us from India, but KUROKAWA (1966, p. 607) has reported it from Darjeeling under s. n. *Parmelia boliviana* Nyl., a taxon which has been synonymized by HALE (l.c.). The following characters of the plant are based on HALE (1975a, p. 54) for ready reference.

Thallus corticolous or saxicolous, adnate to substratum, rather coriaceous, 6–15 cm in diameter, ashy white to grey, lobes sublinear, discrete to crowded, 2–6 mm wide, upper surface plane to convex, distinctly white maculate, rarely lobulate-lacinulate towards centre; isidia and soredia absent; lower side densely rhizinate, rhizinae densely dichotomously branched; medulla white. Apothecia 2–10 mm in diameter, spores $12-16 \times 6-9 \mu\text{m}$.

Thallus K+ yellow; medulla K—, C— or + orange, KC+ orange, P—; atranorin, barbatic acid, 4—0 demethylbarbatic acid, obtusatic and norobtusatic acid present.

42. ***Parmelia pindarensis* Awasthi & S. Singh sp. nov.**

Plate 8, Fig. 6

Thallus saxicola, adnatus, albide cinerescens, lobis subdichotomae divisis, centro subimbricatis, 1–2 (4) mm latis. Superne planis, isidiis et sorediis destitutus. Subrus niger, modice rhizinosus, ambitu fusco castaneus, anguste nudus vel papillatis; rhizinis nigris, simplicibus vel furcatis. Apothecia adnata, usque 4 mm diametro; hymenium 60–75 μm altum; sporae hyalinae, simplices, $12-17.5 \times 6-11 \mu\text{m}$.

Thallus saxicolous, foliose, closely adnate to substratum, often several thalli confluent into large patches, pale grey to ashy grey, central part of the thallus often breaking up and falling off, subdichotomously sinuate lobate, lobes short, sublinear, 1–2(4) mm wide, imbricate in the central part of thallus, margin eciliate; upper surface smooth, emaculate, shining, numerous pycnidia present; isidia and soredia absent; lower side black, moderately rhizinate, marginal narrow zone dark brown to brown black, erhizinate to with rhizinal papillae; rhizinae black, short, generally simple, rarely furcate, rhizinae distinct in lobes free from substratum; medulla white. Apothecia common, adnate, up to 4 mm in diameter, plane to concave; margin entire to crenulate; disc reddish brown; amphithecium smooth; epithecium brown for 12–20 μm thick region; hymenium 60–75 μm high, hyaline, I+ blue; asci clavate, 50–65 \times 20–25 μm , biserially 8 spored; spores colourless, simple, oval to ellipsoid, 12–17.5 \times 6–11 μm ; paraphyses branched, septate, apices reddish brown, 3–6 μm thick.

Thallus K+yellow; medulla K—, C+pink, KC+ pink, P—; atranorin, gyrophoric acid and protolichesterinic acid present.

The new species *P. pindarensis* is peculiar in forming confluent patches of thalli, flaking

off in the central region, in saxicolous habit, and the peculiar combination of gyrophoric and protolichesterinic acids. It belongs to *P. scytophylla* group.

Holotype—India, Uttar Pradesh, Almora District, Dhakuri to Khati, on way to Pindari Glacier, alt. ca. 2350 m, on roadside boulders, common, June 9, 1970, D. D. AWASTHI 7618 (AWAS).

43. ***Parmelia pluriformis* Nyl.**

Synop. Lich. 1: 381, 1860; *Zahlbr. Cat. Lich. Univ.* 6: 185, 1930.

Hypotrachyna pluriformis (Nyl.) Hale, *Smithsonian Contr. Bot.* No. 25: 55, 1975.

Thallus corticolous, foliose, loosely adnate to substratum along with mosses, 3-5 cm in diameter, pale grey to dark grey, irregularly lobed, lobes sublinear to linear, 1-3.5 mm wide, sinuate lobate and imbricate, peripheral smaller lobules somewhat convex on upper side to canaliculate, margin black rimmed; upper surface smooth, dull to \pm shining; isidia and soredia absent; lower side black, densely rhizinate, marginal zone dark brown with rhizinal papillae; rhizinae mostly simple, few dichotomously branched; medulla white. Apothecia few, up to 2 mm in diameter, substipitate, \pm lobulate; disc brown to dark brown; amphitheciium smooth; hymenium 70-80 μ m high, asci well fertile, 59-70 \times 20-30 μ m in size, biserially 8 spored; spores colourless, simple, oval to ovoid ellipsoid 12-18.5 \times 6-11 μ m.

Thallus K+ yellow; medulla K-, C+ rose red, KC+ red, P-; atranorin and gyrophoric acid present.

Parmelia pluriformis shows a close resemblance to *P. scytophylla* in the presence of gyrophoric acid, but is distinct in smaller pale grey thallus, narrow lobes and larger spores. The taxon is known from tropical America.

Specimens examined:

Uttar Pradesh—Uttar kashi district, between Silkara & Gangrani, at Rari hill top, alt. 1800 m, on bark of *Quercus* tree, AWASTHI 836 (AWAS)—the specimen had been determined s. n. *P. scytophylla* by KUROKAWA but the spores are distinctly larger and the thallus is paler and thinner.

44. ***Parmelia pseudomarmariza* Awasthi sp. nov.**

Plate 1, Figs. 3 & 4

Subsimilis *Parmelia marmariza* Nyl., thallo maculato-pseudocyphellato, sed maculis laevis vel elevatis, deinde pseudocyphellatis, rhizinis densis, furcatis, sporae 18-24 \times 12-14 μ m.

Thalls corticolous or lignicolous, foliose, loosely or closely adnate to substratum, 6-10 cm in diameter, grey to dark grey, olivaceous grey in the central part, coriaceous, irregularly lobate; lobes sub-linear, 2-3 (6) mm wide, imbricate; margin ascending, eciliate; upper surface smooth to rough, densely white maculate in the apical parts of the lobes, maculae sparser in mature lobes, somewhat raised from the general surface, irregular in outline, becoming fissured and pseudocyphellate later, cracks not very prominent; isidia and soredia absent; lowerside black, densely rhizinate up to the margin; rhizinae black, simple to much furcate and often dichotomously divided. Thallus 200-250 μ m thick, upper cortex with an external amorphous layer; medulla white, medullary hyphae 4 μ m thick, with granular incrustation. Apothecia shortly pedicellate, 10-20 mm in diameter, imperforate, often lobed by radial cracks, lobes curved; disc dark brown, amphitheciium ridged maculate; hymenium 65-75 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, 18-24 \times 12-14 μ m; paraphyses septate, furcate and conglutinated.

Thallus K+ yellow; medulla K+ deep yellow turning blood red, C-, P+ deep yellow to orange; atranorin and an unknown acid present.

Parmelia pseudomarmariza closely resembles *P. marmariza* in external appearance and

chemical reactions, but differs in the sparser maculations, and much larger spores. The spore size compares favourably with *P. adaugescens*, but the thallus in *P. adaugescens* is conspicuously cracked, while it is not so in *P. pseudomarmariza*.

Holotype—Nepal, E. Nepal, Mewakhola valley, alt. 3300 m, on bark of tree, 28.5.1953, D. D. AWASTHI 2305 (AWAS).

Additional specimens examined:

India, West Bengal—Darjeeling district, Sandakhpoo to Phalut road, alt. 3600 m, on Rhododendron tree trunk, AWASTHI & AGARWAL 67.458 (LWU); near Tongloo Dak Bunglow, alt. 3300 m, on tree trunk, AWASTHI & AGARWAL 67.536 (LWU).

Extra-Indian specimen examined:

Ascent to Sandakhpoo from Nepal side, alt. 3000 m, on dead tree trunk, AWASTHI 2465 (AWAS).

45. ***Parmelia pseudosinuosa*** Asah.

J. Jap. Bot. 26:329, 1951; Lamb. *Index Nom. Lich.* 496, 1963.

Hypotrachyna pseudosinuosa (Asah.) Hale, *Smithsonian Contr. Bot.* No. 25:58, 1975.

Thallus corticolous, foliose, closely adnate to substratum, 4-6 cm in diameter, mineral grey to grey, irregularly minutely sinuate lobate, lobes sublinear, 2-3 mm wide, margin dentate-crenate, eciliate; upper surface smooth, to rugose, dull, emaculate, sorediate along the submarginal area; soralia rarely laminal, capitate to globular, free or confluent and then irregular; lower side black, densely rhizinate; rhizinae dichotomously branched; medulla white. Apothecia absent in specimen examined.

Thallus K+ yellow; medulla K—, C—, KC—, P+ orange red; atranorin and protocetraric acid present.

Parmelia pseudosinuosa externally closely resembles *P. aurulenta*, but differs in the presence of dichotomously branched rhizinae, medulla white, P+ orange red. The taxon is known from eastern Asia.

Specimen examined:

Uttar Pradesh—Almora district, Loharkhet to Dhakuri route, alt. 2250 m, on bark of *Quercus* tree, AWASTHI 7551 (AWAS).

46. ***Parmelia revoluta*** Floerke.

Deutsch. Lich. 1: 11, 1815; Zahlbr. *Cat. Lich. Univ.* 6: 193, 1930.

Hypotrachyna revoluta (Floerke) Hale, *Smithsonian Contr. Bot.* No. 25:60, 1975.

Plate 8, Fig. 2

Thallus corticolous, foliose, closely adnate to substratum, rather thin, delicate, 2-4 cm in diameter, glaucous grey to dark grey (in central part), irregularly dichotomously sinuate-lobate; lobes 1-3 mm wide, discrete, margin crenate; upper surface smooth, \pm shining to faintly pruinose in young lobes, inwards somewhat rugulose, apical region of lobes in submarginal area pustulate-sorediate; pustules small; soredia granular; lowerside black, sparsely rhizinate, marginal zone brown black with sparse rhizinal papillae; rhizinae short, dichotomously branched; medulla white. Apothecia absent in specimens examined.

Thallus K+ yellow; medulla K—, C+ rose-red, KC+ red, P—; atranorin and gyrophoric acid present.

Parmelia revoluta resembles *P. exsecta* in the pustulate-sorediate condition at the subapical region of the lobes, but while the medulla of *P. revoluta* is C+ red, KC+ red (gyrophoric acid present), that of *P. exsecta* is C—.

Parmelia revoluta is widely distributed in Europe and America.

Specimens examined:

Tamil Nadu—Nilgiri hills, on way to Doddabetta peak, alt. 1800 m, on bark of tree, and on Eucalyptus bark at base, SINGH 73.369, 73.371, 73.392 (LWU); Emerald road, near Mithorai, on bark, SINGH 73.502 A (LWU); Kilkotagiri to Konada, alt. 1800 m, on bark of tree, AWASTHI & SINGH 71.40 (LWU); Palni hills, Kodaikanal, alt. 2100 m, on bark of tree, HÖEG 2527 (AWAS).

47. ***Parmelia rhabdiformis*** Kurok.

In HALE and KUROKAWA, *Contr. U. S. Nat. Herb.* 36: 183, 1964.

Hypotrachyna rhabdiformis (Kurok.) Hale, *Smithsonian Contr. Bot.* No. 25: 62, 1975.

We have not been able to collect the specimen of this taxon from India, but KUROKAWA (1967) has reported its presence in Nepal Himalayas, and it is likely to occur in the adjacent Indian Himalayan region and therefore a description based on the type description is given below for ready reference.

Thallus corticolous, foliose, adnate to substratum, about 8 cm in diameter, whitish buff, irregularly lobed, lobes sublinear, 2-6 mm wide, subimbricate; upper surface plane, shining, emaculate, isidiate; isidia simple; lower side black, densely rhizinate; rhizinae dense and finely dichotomously branched; medulla white. Apothecia 1-5 mm in diameter, disc brown; amphithecium isidiate; hymenium 60-80 μ m high, spores colourless, simple, 15-21 \times 6-8 μ m.

Thallus K+ yellow; medulla K+ yellow turning red, C—, P+ orange red; atranorin and norstictic acid present.

48. ***Parmelia ricasolioides*** Nyl.

Flora, 70: 135, 1887; *Zahlbr. Cat. Lich. Univ.* 6: 197, 1930.

Plate 2, Fig. 1

Thallus corticolous, foliose, loosely adnate to substratum, 4-5 cm across, bright bluish green when collected, glaucous grey, dark grey to olivaceous grey in herbarium, irregularly lobate; lobes 2-5 mm wide, imbricate; margin dentate, eciliate; upper surface smooth, with rounded sparse pseudocyphellae; isidia and soredia absent; lower side black, rhizinate up to the margin; rhizinae simple to woolly squarrose branched; medulla white. Apothecia plenty, 0.75-1.5 mm in diameter, constricted at base, concave; margin crenate inflexed and white rimmed intermittently; disc dark brown; amphithecium smooth; hymenium 60-75 μ m high, asci 8 spored; spores colourless, simple, oval ellipsoid, 12-17 \times 6-9 μ m (NYLANDER: in type specimen 16-20 \times 9-11 μ m).

Thallus K+ yellow; medulla K+ yellow turning red, C—, P+ orange red; atranorin and salacinic acid present.

Parmelia ricasolioides is characterized by the sparse pseudocyphellae, absence of isidia and soredia and small concave apothecia. The rounded pseudocyphellae show some resemblance to members of *P. borreii* group, but in this species they are sparse and medulla is K+ red and C—.

Specimens examined:

Arunachal Pradesh—(N.E.F.A.), Perila hill, alt. 2745 m, on dead wood, 1958, PANIGRAHI 16079 A (AWAS)—det. HALE "compared with holotype"; Manipur—WATT 6946 (BM).

49. ***Parmelia rigidula*** Kurok.

In HALE & KUROKAWA, *Contr. U. S. Nat. Herb.* 36: 184, 1964.

Hypotrachyna rigidula (Kurok.) Hale, *Phytologia*, 28: 341, 1974.

Plate 7, Fig. 6

Thallus corticolous, foliose, adnate to substratum, coriaceous, 6-10 cm in diameter,

irregularly lobate, mineral grey to dark grey; lobes up to 10 mm wide, sometimes with 1-2 mm wide secondary lobules developed, lobes imbricate, \pm convolute; upper side smooth, dull to shining, emaculate, but with numerous black dots of pycnidia; isidia and soredia absent; lower side black, densely rhizinate up to margin, sometimes marginal zone erhizino-se and shining; rhizinae repeatedly dichotomously branched and sometimes projecting beyond the margin; medulla yellow. Apothecia common, up to 16 mm in diameter, substipitate, constricted at base, imperforate, entire to ultimately \pm lobulate by splitting; disc dark brown; amphithecium smooth; hymenium 80-90 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, $13-20 \times (6) 8-12 \mu$ m.

Thallus K+yellow; medulla K—, C—, KC—, P—; only atranorin found present in crystal tests.

Parmelia rigidula is closely related to *P. scytodes* and *P. scytophylla* both discovered from Darjeeling area like *P. rigidula*. But *P. rigidula* has yellow medulla and is negative to usual chemicals in medulla. The lobing of apothecia is similar to *P. scytophylla*, but the spores in that species are smaller (8-9 μ m).

Specimens examined:

Sikkim—Lachen, alt. 3600 m, HOOKER 1992 (BM). West Bengal—Tiger Hill, alt. 2550 m, AWASTHI & AGARWAL 67.44, 67.56 (LWU); Tongloo, alt. 3000 m, WATT 7035 (BM)—det. HALE, and cited in HALE and KUROKAWA (1964, p. 184). The type specimen is from Darjeeling, Phalut area.

50. ***Parmelia rudecta* Ach.**

Synop. Lich. 197.1814; *Zahlbr. Cat. Lich. Univ.* 6: 197, 1930; Hale, *Svensk Bot. Tidsk.* 59: 45, 1965.

Plate 1, Fig. 6

Thallus saxicolous or corticolous, foliose, loosely (over rock) to closely (on bark) adnate to substratum, crisp and \pm fragile, yellowish grey to darker grey, particularly in the central part due to dense isidiate condition, 6-8 cm in diameter, lobes 3-6 mm wide, subrotund, \pm ascending, margin crenate-dentate, eciliate; upper surface smooth to rough, sometimes reticulately rugulose near the margin of the lobes, pseudocyphellate; pseudocyphellae distinct in peripheral region of lobes, centrally isidia developing along the margin of the lobes and also along the margin of the pseudocyphels and thus laminal; isidia initially simple, terete, eventually coralloid and flattened lacinulate, 0.5×1 mm in size; lowerside pale grey to pale brown, densely rhizinate throughout the lower surface, a narrow 1-2 mm wide marginal zone \pm erhizinate or with papillae; rhizinae simple, slender, concolorous with lowerside; medulla white. Apothecia very rare (seen in two specimens only), sessile, laminal, up to 5 mm in diameter, over mature apothecia cracked lobulate, disc brown; amphithecium smooth, pseudocyphellate; hymenium 50-80 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid $11-17 \times 5.5-9.5 \mu$ m, paraphyses clavate.

Thallus K—; medulla K—, C+ red, KC+ red, P—; atranorin and lecanoric acid present.

Parmelia rudecta though shows similarity to *P. flaventior* and *P. borrevi* in the presence of pseudocyphels, but is distinguished by the crisp, fragile isidiate thallus and presence of lecanoric acid. The taxon is widely distributed in the temperate regions of the world.

Specimens examined:

Himachal Pradesh—Kulu to Rohtang pass, alt. 2400 m, on tree, AWASTHI *et al.* (LWU); From Manali to Hemptah, HÖEG 1852 (AWAS); Manali, 1800 m, AWASTHI *et al.* (LWU); Manali, on *Cedrus deodara* bark, AWASTHI & DANGE 75.001, 75.004, 75.019 (LWU); Parbati river valley, Manikaran to Pulga route, alt. 1600 m to 2100 m, on bark of tree, AWASTHI & DANGE, 75.050, 75.101, 75.104 B (LWU); above Pulga Rest House, alt. 2250—2350 m, on Pine tree trunks, AWASTHI & DANGE 75.131 B, 75.148, 75.181 B (LWU). Tamil Nadu—Nilgiri hills, Coonoor, alt. 1600 m, over rocks, AWASTHI & SINGH 70.1313, 70.1317 (LWU); on bark,

AWASTHI & SINGH 70.1361, 70.1385 (LWU); Kattari Rly. Station, alt. 1500 m, on ground, SINGH 71.812 (LWU); Avalanche, Hatchey Shola, alt. 2100 m, SINGH 71.630 (LWU); near Power House, on tree, SINGH 71.785 (LWU); Doddabetta peak, alt. 2500 m, on bark, AWASTHI & SINGH 71.174 (LWU)—the surface of thallus minutely reticulately cracked in older parts; Doddabetta peak, alt. 2250 m, SINGH 71.1068, 71.1082, 71.1109, 71.1118 (fertile) (LWU); Kodanad, alt. 2000 m, on *Jacaranda* bark, AWASTHI & SINGH 70.1407 (LWU); Kilkotagiri to Konada, alt. 1800 m, on tree trunk, AWASTHI & SINGH 71.5 (LWU); Ootacamund Bot. Garden, on tree, AWASTHI 4453 (AWAS)—det. HALE; AWASTHI & SINGH 71.282 A (LWU); Ootacamund to Kotagiri route, alt. 2100 m, on tree trunk, SINGH 71.1108 (LWU); Kotagiri to Kodanad, 1800 m, on tree trunk, SINGH 71.928, 71.934, 71.941 (LWU); Kotagiri road near Doddabetta, on tree, SINGH 73.689 (LWU); Pykara forest, alt. 2100 m, on tree trunk, AWASTHI & SINGH 71.194 (fertile), 71.229 (LWU); Sholurmatta near Kilkotagiri, alt. 1550 m, on tree trunk, SINGH 71.913 (LWU); Ootacamund to Mysore route, alt. 2100 m, on moss over tree trunk, AWASTHI 4525 (AWAS); Palni hills, Kodaikanal, on tree trunk, Singh 70.512 (LWU); Pillar Rocks, alt. 2250 m, AWASTHI & SINGH 70.272 (LWU); on way to Kuranjiandvar temple, alt. 1800 m, on bark, SINGH 70.1294 (LWU); Pambampuram, on tree trunk, SINGH 70.574 (LWU)—fertile; Shembaganur, S. H. College, alt. 1800 m, on tree, AWASTHI 4377 (AWAS)—det. HALE, 1965; FOREAU & AWASTHI 4304 (AWAS)—det. Hale; Uttar Pradesh—Almora district, Jageshwar, alt. 1900 m, on tree trunk, AWASTHI 3501 (AWAS); Ranikhet to Chauhattia route, alt. 1900 m, on tree trunk, AWASTHI & DANGE 74.81 (LWU); over stones, AWASTHI 3525 (AWAS), comm, SESHADRI, 3606 (AWAS).

51. *Parmelia saxatilis* Ach.

Meth. Lich. 204, 1803; *Zahlbr. Cat. Lich. Univ.* 6: 198, 1930.

Thallus saxicolous, foliose, loosely adnate to substratum, 4-6 cm across, ashy grey to dark grey or brownish grey, subdichotomously to irregularly lobate, lobes sublinear, 2-4 mm wide, subimbricate, marginally subascending, crenate to dentate, eciliate; upper surface smooth, effigurate maculate in young lobes; maculae often raised over general surface, turning to pseudocyphellae in older lobes; isidia on margins of pseudocyphellae, globular to oblong, simple to coralloid branched; lower side black, densely rhizinate up to the margin; rhizinae black, simple to squarrosely branched and projecting beyond the margin of lobes and may be confused for cilia; medulla white. Apothecia absent in specimen examined.

Thallus K+ yellow; medulla K+ yellow turning red, C—, P+ orange red; atranorin and salacinic acid present.

Parmelia saxatilis is distinctive in being effigurate maculate, and becoming pseudocyphellate and isidiate in older lobes. The effigurate maculate condition is similar to *P. sulcata*, but in that species linear elongate soralia are formed in older lobes and coarse granular soredia develop on them. Both the species are similar in chemical reactions. The taxon is widely distributed in the temperate regions on bark of tree and over rocks, though known from few collections from India.

Specimen examined:

Uttar Pradesh—Almora district, Phurkia to Mirtoli near Pindari Glacier, alt. 3450 m, over boulders, AWASTHI 7772 (AWAS)—sterile.

The taxon has also been reported from Sikkim by KUROKAWA (1966, p 610).

52. *Parmelia scytodes* Kurok.

In Hale & Kurokawa, *Contr. U. S. Nat. Herb.* 36: 185, 1964, pl. 6, fig. 1.

Hypotrachyna scytodes (Kurok.) Hale, *Phytologia*, 28: 341, 1974

The type material of this taxon is from Batasi, Darjeeling. We have not been able to collect any specimen conforming to this taxon. The following description is based on the type description for ready reference.

Thallus adnate to bark, rather coriaceous, about 20 cm across, pale grey, irregularly lobed, lobes 2-5 mm wide, black rimmed, upper surface smooth to rugose on older lobes,

emaculate; isidia and soredia absent; lower side densely rhizinate, rhizinae black, moderately dichotomously branched; medulla white. Apothecia not known.

Thallus K+ yellow; medulla K—, C—, KC+ orange, P+ orange red; atranorin, barbatic acid and an unidentified P+ orange red substance present.

53. *Parmelia scytophylla* Kurok.

In Høle & Kurokawa, *Contr. U. S. Nat. Herb.* 36: 185, 1964, pl. 7, fig. 2.

Hypotrachyna scytophylla (Kurok.) Hale, *Phytologia*, 28: 342, 1974.

Plate 7, Fig. 2

Thallus corticolous, or sometimes saxicolous, foliose, closely adnate to substratum, grey, lead grey to olivaceous grey, thick coriaceous, 6-10 cm in diameter, irregularly sinuate lobed; lobes sublinear to irregular, 2-6 mm wide, margin black rimmed, crenate, often with cilia like growth of rhizinae; upper surface smooth, dull to shining, often with numerous black dots or areas of aborted (?) apothecia; isidia and soredia absent; lower side black, densely rhizinate up to the margin; rhizinae mostly simple, few dichotomously branched, black, and 1 mm long; medulla white. Apothecia common, adnate, substipitate, 8-10 (20) mm in diameter, larger ones often irregularly split lobulate, imperforate; disc dark brown; amphitheciium smooth; hymenium 40-50 μ m high, asci 8 spored; spores colourless, simple, oval ellipsoid, 6-9 \times 3.5-5 μ m.

Thallus K+yellow; medulla K—, C+ rose-red, KC+ red, P—; atranorin and gyrophoric acid present.

Parmelia scytophylla is close to *P. scytodes* and *P. rigidula* in the thick coriaceous thallus. *P. scytodes* is yet not known in fertile condition, while the other two taxa have large apothecia, often lobed by splitting, but the spores in *P. scytophylla* are smaller in comparison to *P. rigidula*. The taxon is known from Himalayas only.

Specimens examined:

Uttar Pradesh—Pithoragarh district, Johar, near Ratpani, above Girgaon, alt. 2250 m, over rock, AWASTHI 811 (AWAS)—det. Kurokawa. West Bengal—Darjeeling district, near Rimbick, on dead wood stump. AWASTHI 12 (AWAS)—det. Kurokawa; near Sandakhpoo, alt. 3500 m, on trunk and twigs of *Rhododendron* tree, AWASTHI & AGARWAL 67.362 A, 67.419, 67.448, 67.454 (LWU).

The taxon has also been reported from Darjeeling and Sikkim by KUROKAWA (1966, p. 610).

54. *Parmelia sensibilis* Stein & Zahlbr.

Bot. Jahrb. 60: 522, 1926; Zahlbr. *Cat. Lich. Univ.* 6: 210, 1930.

Bulbothrix sensibilis (Stein & Zahlbr.) Hale, *Phytologia*, 28: 481, 1974.

Thallus corticolous, foliose, closely adnate to substratum, 2-4 cm in diameter, mineral grey to dark grey, irregularly sinuate lobate, lobes linear, narrow, 2-6 mm wide, imbricate, plane to \pm convex, apices rounded to dentate; margin bulbate ciliate, basal bulbate part distinct, cilia often indistinct; upper surface dull, sometimes with black punctate pycnidial growths, smooth to rough, emaculate; isidia and soredia absent; lower side black, densely shortly rhizinate; rhizinae robust, marginal 2-3 mm wide zone naked or with rhizinal papillae and dark brown. Thallus 200-250 μ m thick, medulla white. Apothecia adnate, 2-4 mm in diameter, disc dark brown, amphitheciium smooth; hymenium 30-40 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid, 8-11 \times 5-8 μ m. (The Indian specimen with immature apothecia, the spore characters are based on Sri Lanka specimen cited).

Thallus K+ yellow; medulla K+red, C—, P+orange; atranorin and salacinic acid present.

Parmelia sensibilis somewhat resembles *P. bulbochaeta*, but is distinguished by the medulla K+ red, P+orange (salacinic acid). The taxon is known from Africa.

Specimen examined:

Tamil Nadu—Palni hills, Kodaikanal, on way to Kuranjiandvar temple, alt. 1800 m, on bark, SINGH 70.1292 (LWU).

Extra-Indian specimen examined:

Sri Lanka—(Ceylon), Central Province, THWAITES 33, and 33 b, pr. p. (BM).

55. ***Parmelia setschwanensis*** Zahlbr.

In Handel Mazzetti, *Symb. Sin.* 3: 182, 189, 1930; Zahlbr. *Cat. Lich. Univ.* 8: 567, 1932.

Bulbothrix setschwanensis (Zahlbr.) Hale, *Phytologia*, 28: 481. 1974.

Plate 2, Fig. 5

Thallus corticolous, rarely saxicolous, foliose, closely adnate to substratum, 8-10 cm in diameter, rather coriaceous, ashy grey to dark grey, subdichotomously uniformly sinuate lobate, lobes sublinear, unequally 3-6 mm wide, margin crenate, bulbate ciliate, cilia sometimes represented by the basal bulb only; upper surface smooth to rugose, apices of lobes \pm shining and with pycnidial dots; isidia and soredia absent; lower side pale brown, with short rhizinae throughout the surface, marginal zone with rhizinal papillae; medulla white. Apothecia numerous, substipitate, 3-5 mm in diameter, imperforate, concave to plane; disc brown, amphithecium smooth; hymenium 70-80 μ m high; asci 8 spored; spores colourless simple, oval ellipsoid, 12-16 (22) \times 6-10 μ m.

Thallus K+ yellow; medulla K+yellow turning red, C—, P+ orange red; atranorin and salacinic acid present.

Parmelia setschwanensis closely resembles *P. meizospora* in general habit, spore size and chemical reactions, but is distinguished by the more closely adnate thallus with shorter rhizinae, and pale brown lower side. The taxon has previously been known from China.

Specimens examined:

Arunachal Pradesh—(N.E.F.A.); Paya to Shoeling, alt. 360 m, ROLLA RAO 10885 (AWAS); Uttar Pradesh—Pithoragarh district, Askote, below Sunkote village, alt. 1350m, on bark of *Alnus nepalensis* tree, AWASTHI 3316 (AWAS)—det. HALE. West Bengal—Darjeeling district, Kurseong, alt. 1500 m, over stone, AWASTHI & AGARWAL 66.333 (pr. p.) (LWU).

The taxon has also been reported from Darjeeling, Kurseong, Rimbick by KUROKAWA (1966, p. 610).

Extra-Indian specimen examined:

Nepal—E. Nepal, Mewakhola valley, above Tankhu, alt. 2250 m, on tree twigs, AWASTHI 2216 (AWAS).

56. ***Parmelia simplicior*** Hale

Bryologist, 75: 99, 1972.

Parmelina simplicior (Hale) Hale, *Phytologia*, 28: 483, 1974.

Plate 5, Fig. 5

Thallus corticolous foliose, loosely adnate to substratum, 6-10 cm in diameter, whitish grey to dark grey or olive grey, irregularly sinuate lobate; lobes sublinear, convolute and imbricate, 3-5 mm wide, margin eciliate to sparsely ciliate especially in axils; upper surface plane, dull, emaculate; isidia and soredia absent; lower side black, sparsely rhizinate, marginal narrow zone erhizinate shining or with rhizinal papillae; rhizinae simple; medulla white. Apothecia common, adnate, 3-6 mm in diameter, margin inflexed; disc brown, smooth; hymenium 55-65 μ m high, asci 40-45 \times 20 μ m, 8 spored; spores very rarely mature, colourless, simple, oval ellipsoid, (9) 12-16 \times 5-8 μ m, (spores *vide* HALE 6 \times 4 μ m).

Thallus K+ yellow; medulla K+ yellow turning red, C—, P+ orange; atranorin and salacinic acid present.

Parmelia simplicior shows some resemblance to the *P. aurulenta* group in the nature of the lobes, but the medulla in this species is white and contains salacinic acid. HALE (1972) had indicated a relationship to *P. wallichiana*, which however has much larger lobes and is isidiate though in chemistry the two taxa show similarity. HALE had mentioned the spore size $6 \times 4 \mu\text{m}$ but in the isotype (initially designated as Holotype by HALE) the spores are larger. Since the spores are rarely mature and are rarely liberated from asci the dimensions show the variation in the two observations. The taxon is restricted in western India.

Specimens examined:

Maharashtra—Panchgani, on tree bark, AWASTHI 4056 (AWAS—isotype), 4051 (AWAS); near Lonavla along road to Poona, on *Ficus* tree bark, AWASTHI 4085 (AWAS)—det. HALE.

57. ***Parmelia subaurulenta* Nyl.**

Flora, 68: 606, 1885; *Zahlbr. Cat. Lich. Univ.* 6:168, 1930 sub. *P. homogenes*.

Parmelina subaurulenta (Nyl.) Hale, *Phytologia*, 28: 483, 1974.

Plate 5, Fig. 3

Thallus corticolous, foliose, loosely to closely adnate to substratum, 6-10 cm in diameter, mineral grey to dark grey, irregularly to subdichotomously sinuate lobate, lobes 2-4 mm wide, sublinear, sometimes secondary lobules present in the central part of thallus which are much smaller; margin ciliate, especially distinct at axils; upper surface dull, plane to rugulose; isidia and soredia absent; lower side black, rhizinate up to the margin; rhizinae simple to scarcely squarrose branched, up to 1 mm long; medulla yellowish. Apothecia numerous, crowded, adnate, constricted at base, (1) 2-3 mm in diameter; disc red brown to brown, smooth; margin entire to crenulate; amphithecium smooth; hymenium 45-60 μm high; asci 8 spored; spores colourless, simple, oval ellipsoid, 6-11 (14) \times 4.5-7 (8) μm .

Thallus K+ yellow; medulla K—, C—, KC—, P—; only atranorin present in crystal tests, though zeorin, entothecin are also reported in the taxon.

Parmelia subaurulenta closely resembles *P. homogenes* in the general habit of the thallus, the pigmented medulla, but differs in the smaller size of the spores. The taxon is widely distributed in the Himalayan region and in S. Indian hills and extends eastwards in Asia.

Specimens examined:

Tamil Nadu—Palni hills, Kodaikanal, alt. 2100 m, on bark of tree, AWASTHI & SINGH 69.26, 70.186 (LWU); on road side trees, DEGELIUS As—352 (DEGEL); Pambampuram, alt. 2250m, on bark of tree, SINGH 70.534 (LWU); Kodaikanal to Berijam road, alt. 2250 m, on tree bark, AWASTHI 4219 (AWAS)—det. HALE, 1965. Uttar Pradesh—Almora district Khati to Dwali, alt. 2400 m, on tree bark, AWASTHI 7631 (AWAS); Loharkhet to Dhakuri road, on bark of *Quercus* trunk, AWASTHI 7553 (AWAS); Dehradun district, Mussoorie, alt. 1800—2100 m, on bark of tree, AWASTHI 3809 (AWAS)—det. HALE; Pithoragarh district, Askote, alt. 1650 m, on bark, AWASTHI 3974 (AWAS); West Bengal—Darjeeling district, Kurseong, alt. 1650 m, on bark, AWASTHI 3919 (AWAS)—det. HALE, 1965; Darjeeling, AWASTHI 22, 3921 (AWAS)—det. HALE, 1967; Kalimpong, Munsong road, alt. 1500 m, on tree trunk, AWASTHI & AGARWAL 67.315 B (LWU).

The taxon has also been reported from Phalut, Darjeeling by KUROKAWA (1966, p. 610).

58. ***Parmelia sublaevigata* (Nyl.) Nyl.**

Ann. Sci. Nat. ser. 5, 7:306, 1867; *Zahlbr. Cat. Lich. Univ.* 6: 213, 1930.

Parmelia tiliacea var. *sublaevigata* Nyl. *Synop. Lich.* 1: 383, 1860.

Hypotrachyna sublaevigata (Nyl.) Hale, *Smithsonian Contr. Bot.* No. 25:66, 1975.

Plate 7, Fig. 1

Thallus corticolous (ramulicolous), foliose, closely adnate to substratum, covering up to 10 cm long twig, mineral grey to grey, irregularly lobed, lobes subrotund, sinuate, 3-5 mm wide, crenate-dentate, margin eciliate; upper surface dull, smooth in peripheral region, rugose inwards; isidia and soredia absent; lowerside black, densely rhizinate up to the margin; rhizinae short, dichotomously branched; medulla white. Apothecia numerous, substipitate, 4-7 mm in diameter, plane to concave (due to incurved margin), imperforate; disc red brown; amphithecium smooth to rugulose; hymenium 45-65 μm high; asci 8 spored; spores colourless, simple, oval ellipsoid, 6-9 \times 4-5 μm .

Thallus K+ yellow; medulla K+ yellow turning red, C-, P+ orange red; atranorin and salacinic acid present.

Parmelia sublaevigata is distinctive in its subrotund closely adnate lobes, large numerous apothecia, chemical reactions, and absence of isidia and soredia. The species is distributed in warm tropical regions.

Specimen examined:

Tamil Nadu—Nilgiri hills, Upper Bhowani Road from Avalanche, on way to Deverbetta, alt. ca. 2400 m, on twigs of tree, SINGH 71.695 (LWU).

59. ***Parmelia submutata* Hue**

Now. Arch. Mus. ser. 4, 1: 172, 1899; ZAHLBR. Cat. Lich. Univ. 6: 215, 1930.

Plate 1, Fig. 5

We have not been able to collect any specimen from India to conform to this taxon, but it has been reported from Walunchung Gola, E. Nepal by KUROKAWA (1966, p. 610), and it is likely that it may be present in adjacent Indian Himalayan region. It therefore has been included here as reference. The following description is based on a specimen from Tibet (cited below) determined by HALE in 1963.

Thallus corticolous, foliose, crisp and coriaceous, closely adnate to substratum, 4-6 cm in diameter, subdichotomously sinuate lobate, mineral grey to light pale grey, lobes linear, 4-8 mm wide, central part of thallus with 1-2 mm wide lacinules, margin eciliate; upper surface smooth, densely white maculate, maculae getting cracked pseudocyphellate in older lobes; isidia and soredia absent; lower side black, densely rhizinate up to the margin; rhizinae squarrosely branched, lateral branches dense woolly. Thallus ca. 325 μm thick; medulla white. Apothecia numerous, substipitate to sessile, adnate, 4-7 mm in diameter; disc plane, brown, shining; margin thin; amphithecium yellowish, slightly rugose, not maculate; hymenium 45-55 μm high; asci 8 spored; spores colourless, simple, oval ellipsoid, 8-12 \times 5-7 μm .

Thallus K+yellow; medulla K+orange red, C-, P+orange.

Extra-Indian specimen examined:

S. E. Tibet—Pome, Yigrong Tso (south side) alt. 2250 m, on tree trunk, 1947, LUDLOW & SHERRIF 12200 (BM)—det. HALE, 1963.

60. ***Parmelia subrudecta* Nyl.**

Flora, 69: 320, 1836, and *Lich. Nov. Zeland.* 26, 1888; *Zahlbr. Cat. Lich. Univ.* 6: 215, 1930; Hale, *Sv. Bot. Tidskr.* 59, H. 1: 42, 1965.

Thallus corticolous or saxicolous, foliose, loosely to closely adnate to substratum, 4-6 cm in diameter, irregularly lobate, multifid, lobes at the periphery 1-3 mm wide, centrally up to 5 mm wide, crenate-dentate, margin eciliate; ashy grey, bluish grey to faintly olivaceous grey; upper surface lacunose, \pm shining at the marginal region, pseudocyphellate; pseudocyphels eventually becoming sorediate; soralia thus laminal and also marginal, dis-

tinged or rarely confluent, somewhat smaller than those in *Parmelia borrieri*; lower side pale yellow to pale brown throughout, smooth, short simple rhizinae throughout the lower side; medulla white. Apothecia absent in the specimens examined.

Thallus K+yellow; medulla K—, C+red, KC+red, P—; atranorin and lecanoric acid present.

Parmelia subrudecta closely resembles *P. borrieri* in the pseudocyphellate and sorediate condition; the soralia are generally laminal in *P. subrudecta*, and the lower side is pale brown. However the distinction is made by the presence of lecanoric acid in *P. subrudecta* and of gyrophoric acid in *P. borrieri*. The taxon is distributed in tropical parts of America and also in New Zealand, while in India it occurs in subtropical to temperate regions.

Specimens examined:

Himachal Pradesh—Parbati river valley, near Pulga, alt. 2250 m, on conifer tree trunk, AWASTHI & DANGE 75.131 A (LWU). Tamil Nadu—Nilgiri hills, Coonoor, alt. 1600 m, on roadside boulders, AWASTHI & SINGH 70.1312 (LWU); Kilkotagiri to Konada, alt. 1800m, on bark, AWASTHI & SINGH 71.6 (LWU); Konada tea estate, on bark of *Terminalia* tree, AWASTHI & SINGH 71.57 (LWU); Kotagiri to Konada, near Finger Point, on bark, SINGH 71.919 (LWU); near Doddabetta, on bark, SINGH 73.673 (LWU); Palni hills, Kodaikanal, Pambampuram, on bark of tree, alt. 2250 m, SINGH 70.568 (LWU); Uttar Pradesh—Almora district, Rani-khet to Chaubattia, alt. 1800 m, on bark of tree, AWASTHI 3547 (AWAS).

61. ***Parmelia sulcata* Tayl.**

In Mack. *Flora Hibernica*, 2: 145, 1836; Zahlbr. *Cat. Lich. Univ.* 6: 216, 1930.

Plate 1, Fig. 1

Thallus corticolous, foliose, closely adnate to loosely attached to substratum, rosette-form, 4—8 (to more) cm in diameter, bluish grey, ashy grey to dark grey, irregularly lobate, lobes sub-linear, imbricate, subtruncate, 2—5 mm wide; upper surface dull, smooth, with effigurate maculae in lobe apices, maculate areas fissured pseudocyphellate in older parts and then developing to linear elongate to rounded soralia; soredia coarse granular developing from the margin of the pseudocyphellae; lower side black, densely rhizinate up to the margin, rhizinal papillae along the margin; rhizinae simple, moderately thick; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K+yellow turning red, C—, P+orange red; atranorin, salacinic acid and protocetraric acid present.

Parmelia sulcata is distinctive in being maculate-pseudocyphellate and sorediate. The taxon is widely distributed in the dry temperate and north boreal regions of the world.

Specimens examined:

Himachal Pradesh—Parbati river valley, Pulga, alt. 2250—2400 m, conifer tree trunks, AWASTHI & DANGE 75.138, 75.167, 75.173, 75.179, 75.285 (LWU). Jammu & Kashmir—Gulmarg range, alt. 2250 m, Mujoo 70.110 (LWU); Yarikale, KAPOOR 993 (AWAS); Pahalgaoon, alt. 2100 m, on bark of Pine tree, AWASTHI *et al.* (LWU); SESHADRI 3404 (AWAS); AWASTHI 2628 (AWAS)—*vidi* HALE, 1967.

62. ***Parmelia texana* Tuck.**

Amer. J. Arts & Sci. ser. 2, 25: 424, 1858; Zahlbr. *Cat. Lich. Univ.* 6: 220, 1930.

Pseudoparmelia texana (Tuck.) Hale, *Phytologia*, 29: 191, 1974.

Parmelia cingalensis Stirt. *Proc. Phil. Soc. Glasgow*, 10: 159, 1876; Zahlbr. *Cat. Lich. Univ.* 6: 161, 1930.

Plate 5, Fig. 2

Thallus corticolous, foliose, closely adnate to substratum, 6—10 cm in diameter, mineral grey to yellowish grey, irregularly sinuate lobate, lobes sublinear, compact and close in the central part, discrete in the peripheral region, (0.5) 2—4 m wide, crenate to dentate apically, margin eciliate; upper surface smooth to minutely lacunose to sometimes reti-

culately cracked; soralia laminal to submarginal, generally developing from verrucial protuberances, becoming profusely sorediate later, soredia ashy grey to darker grey; lower side black, sparsely rhiziniate; rhizinae short, thick, up to the margin; medulla white. Apothecia rarely present, adnate, constricted at base, 2–3 mm in diameter; disc plane, brown; amphithecium sorediate; hymenium 40–55 μ m high, asci 8 spored; spores colourless, simple, oval ellipsoid, 8–13 (16) \times 5.5–8 (9.5) μ m.

Thallus K+yellow; medulla K—, C—, KC+reddish, P—; atranorin and divaricatic acid present (KC+reddish substance reported unknown).

Parmelia texana resembles *P. aptata*, but mainly differs in a thinner thallus, profuse soredia, and presence of divaricatic acid. The taxon is widely distributed in the tropical-subtropical regions of the world.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Meghalaya—Shillong, near Mawlai, alt. 1600 m, on bark of Pine tree, AWASTHI 7904 A (AWAS); Shillong to Jowai route, alt. 1500 m, on bark of Pine tree, AWASTHI 8009 (AWAS). Tamil Nadu—Nilgiri hills, Kilkotagiri to Konada, alt. ca. 1800 m, on bark, AWASTHI & SINGH 71.28 (LWU)—fertile; Konada tea estate, alt. 1800 m, on bark, AWASTHI & SINGH 71.16 (LWU)—fertile; Kotagiri to Kodanad, near Finger Point, alt. 1900 m, SINGH 71.933 (LWU); Sholurmatta, alt. 1600 m, on bark of tree, SINGH 71.888 (LWU); Mettupalayam road, Adderly Shola, SINGH 71.840 (fertile), 71.858 (LWU); Palni hills, Kodaikanal, alt. 2100 m, SESHADRI 3732 (AWAS)—det. KUROKAWA; FOREAU 4152 (AWAS)—det. HALE; HÖEG 2517 (AWAS)—det. KUROKAWA; SINGH 70.782 (LWU); Kodaikanal, Bryant Park, SINGH 70.1054 (LWU); Croackers Walk, AWASTHI & SINGH 69.12 (LWU); Fairy Falls, SINGH 70.1224 (LWU); Pillar Rocks area, alt. 2200 m, on bark, SINGH 70.744 (LWU); Bear Shola, SINGH, 70.800 (LWU); Shembaganur, on tree bark, FOREAU 3778 (AWAS)—fertile, det. Hale; AWASTHI 3779 (AWAS); S. H. College, on bark, AWASTHI 4256 (AWAS)—det. Hale; Tiger Shola, alt. 1650 m, AWASTHI & SINGH 70.150 (LWU); S. H. College area, alt. 1800 m, DEGELIUS As—235 (DEGEL)—det. HALE; La Providence, alt. 2100 m, on Pine bark, DEGELIUS As—270 (DEGEL)—det. HALE, 1965, Kodaikanal, Carlton Hotel, alt. 2100 m, on *Cupressus* bark, DEGELIUS As—276 (DEGEL)—det. HALE, 1965; Booparai area, alt. 1800 m, SINGH 70.1140, 70.1144 (fertile) (LWU); Pambampuram, on bark, SINGH 70.604 (LWU); Panneikodu, alt. 1300 m, on tree, FOREAU 4116 (AWAS)—det. HALE, 1965; Perumal Coffee Plantation, alt. 1600 m, AWASTHI 4343, 4362 (AWAS); SINGH 70.1110 (LWU); Pillar Rocks area, on bark, AWASTHI & SINGH 70.262 (LWU)—fertile; Golf Club area, SINGH 70.641 (LWU)—fertile; Shembaganur pear orchard, on pear tree bark, SINGH 70.860 (LWU).

Extra-Indian specimen examined:

Sri Lanka—(Ceylon), Point de Galle, DICKIE (BM)—holotype of *Parmelia cingalensis* Stirt. Specimen fertile (spores 9–11 \times 6–7 μ m), annotated to *P. texana* by HALE, 1962.

63. *Parmelia thryptica* Hale

The Bryologist, 75: 99, 1972.

Hypotrachyna thryptica (Hale) Hale, *Phytologia*, 28: 342, 1974.

No other specimen has been collected than the type specimen described by Hale from Kerala, northwest of Trivandrum, Ponnudi, collected by DEGELIUS in 1964. The following description is based on the type description as a ready reference.

Thallus corticolous, foliose, adnate, whitish to pale olive white, lobes 2.5–3 mm wide, subirregular, margin eciliate, upper surface breaking at top, non sorediate, lower side black, densely rhizinate, rhizinae dichotomously branched, medulla white. Apothecia absent.

Thallus K+yellow; medulla K+yellow, C—, P+orange; atranorin, stictic acid and constictic acid present.

The taxon is close to *P. dadapetta* but differs in chemical reactions.

64. *Parmelia tiliacea* (Hoffm.) Ach. em. Vain.

Ach. Meth. Lich. 215, 1803; Vain. *Term. Fuez.* 22: 279, 1899.

Plate 3, Fig. 5

Thallus corticolous, foliose, closely adnate to substratum, 8—12 cm in diameter, \pm coriaceous, mineral grey to bluish grey, irregularly lobed, lobes superposing, 2—10 mm wide, sublinear, truncate to notched, margin ciliate; upper surface dull, uneven, maculate, sometimes marginal area \pm shining, older parts of lobes densely isidiate; isidia tubercled to terete cylindrical, simple to branched, darker than thallus, often broken and whitish at apex; lower side black, densely rhizinate, marginal 1-2 mm wide zone dark brown with rhizinal papillae; rhizinae black, simple; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K—, C+red, KC+Red, P—; atranorin and lecanoric acid present.

Parmelia tiliacea is characterized by the maculate upper cortex, isidiate thallus and medulla C+red reaction. In the isidiate condition it shows some similarity to *P. wallichiana*, but the thallus of *P. wallichiana* has subrotund to rotund lobes and medulla is K+red. The taxon is widely distributed in the north temperate region of the world. It shows similarity in isidiate condition to *P. halei* Awasthi.

Specimens examined:

Himachal Pradesh—Kilar, Pangi, 1878, WATT 455 (BM)—det. HALE, 1965; Sach village, alt. 2700 m, WATT 117 (BM)—det. HALE, 1963, 'spores 8-11 \times 5-6 μ m'. Jammu & Kashmir—Gulmarg, Yarikale, alt. 2100 m, on tree trunk, KAPOOR 991 (AWAS)—det. HALE, 1967; Khilanmarg, alt. 2400 m, on tree trunk, AWASTHI *et al.* (LWU); Pahalgaoon, alt. 2100 m, on conifer tree bark, AWASTHI *et al.* (LWU); Srinagar, on bark, KAUL 4006 (AWAS)—det. HALE; Sonamarg, alt. 2400 m, on conifer tree trunk, AWASTHI *et al.* (LWU).

65. ***Parmelia vexans*** Zahlbr.

Fedde Repert. Sp. Nov. 33: 55, 1933; *Zahlbr. Cat. Lich. Univ.* 10: 540, 1940.

Plate 3, Figs. 1 & 2

Thallus corticolous, rarely terricolous, foliose, loosely adnate and pendulous on the substratum, 4-6 cm in diameter, ashy grey to dark grey, laciniolate lobate, laciniae divaricately divided, linear 1—2.5 (4) mm wide, tapering, margin ciliate, cilia black, prominent, 4-5 mm long, simple to dichotomously forked or branched; upper surface convex, \pm smooth, densely covered by cylindrical isidia, isidia often (particularly in specimens from Nilgiri hills) becoming elongate lacinate, dorsiventral and with apical cilia; lower side black, lacunose, concave canaliculate, smooth, shining, with sparse, black, dichotomously branched rhizinae; apical region brown to dark brown; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K+yellow turning red, C—, P+orange red; atranorin and salacinic acid present.

In general habit and branching *Parmelia vexans* closely resembles *Parmelia cirrhata* and *P. nepalensis*, but is distinguished by the presence of isidia. The isidia in Himalayan specimens are cylindrical terete, while in most of the specimens from Nilgiri hills they are elongated lacinate, dorsiventral and with marginal or apical cilia. However, in the same specimen often the different stages of this elongation are present, and thus conclusions may be drawn that the excessive moist and shady condition where the specimens grew may have been responsible for their growth. The presence of transitional stages indicates this change. The species originally reported from Formosa is now known from Himalayas and South Indian hills.

Specimens examined:

Tamil Nadu—Nilgiri hills, Pykara forest range, alt. 2100 m, on tree trunk, AWASTHI & SINGH 71.218 (LWU); Avalanche, alt. 2100 m, on soft sandy soil on ground, SINGH 71.321, 71.570 (LWU); on *Rhododendron*

tree trunk, SINGH 71.361 (LWU); Hatchery Shola, on bark, SINGH 71.640 (LWU); near Power House, on Rhododendron tree trunk, SINGH 71.766 (LWU)—thallus adnate, suborbicular, with short broad lobes; on way to Nilgiri Peak, Carriat Shola, alt. 2250 m, SINGH 72.14 (LWU); Naduvattam Cinchona Plantation, on tree, SINGH 72.106 (LWU). West Bengal—Darjeeling district, Bot. Garden, alt. 1950 m, on twigs, AWASTHI 3834 (AWAS)—det. HALE; Kalimpong, Munsong, AWASTHI & AGARWAL 67.281 A (LWU).

Also reported from Darjeeling by KUROKAWA (1966, p. 610).

66. *Parmelia wallichiana* Tayl.

London J. Bot. 6: 176, 1847; *Zahlbr. Cat. Lich. Univ.* 6: 270, 1930.

Parmelina wallichiana (Tayl.) Hale, *Phytologia*, 28: 483, 1974.

Plate 4, Fig. 1

Thallus corticolous or saxicolous, foliose, loosely attached (generally when saxicolous) to closely adnate (when corticolous) to substratum, 10-15 cm in diameter; mineral grey to dark grey, subdichotomously sinuate lobate; lobes rotund to subrotund, 5-10 mm wide, (rarely up to 20 mm wide); rounded margin usually eciliate, cilia present in notches or axils, short and dense; upper surface smooth and shining at the peripheral region, rugulose rough in older part; isidia dense in the older part of thallus, short to terete, simple to branched, simple isidia cylindrical, brown-black tipped, 0.3×0.9 mm in size, branched isidia variable in size; lower side black, smooth, densely rhizinate in the central part, marginal 2-6 mm wide zone often dark tan, shining erhizinate or with rhizinal papillae; rhizinae simple, black. Thallus 100-150 (200) μ m thick, medulla white. Apothecia infrequently present, adnate, constricted at base, young concave, mature plane with incurved edges up to 15 mm in diameter, imperforate; disc brown to dark brown; amphithecium smooth to faintly rugulose; hymenium 70-95 μ m high; asci 55-70 \times 25 μ m, 8 spored; spores colourless, simple, oval ellipsoid, 12-19 (24) \times 7-13 μ m; paraphyses simple, with brown clavate apices.

Thallus K+yellow; medulla K+yellow turning red, C—, P+orange red; atranorin and salacinic acid present.

Parmelia wallichiana is characterized by the isidiate thallus, rotund to subrotund lobes and medulla K+red, P+orange red. It shows a close similarity to *P. awasthii* but the latter has dichotomously branched rhizinae and contains norstictic acid in addition to the salacinic acid. *Parmelia wallichiana* was placed under section *Amphigymnia* by ZAHLBRUCKNER (1930) apparently on account of broad rotund lobes which sometimes are \pm naked along the margin on lower side. The taxon shows a close affinity to broad lobed *Amphigymnias* with dense rhizinae on under surface and marginal area \pm naked. But then the cilia in *Amphigymnias* when present are generally on rounded lobes not restricted in the notches or axils. The taxon is widely distributed in the tropical and subtropical regions.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Assam—no precise locality, leg. ?, Hb. Hooker, (BM). Himachal Pradesh—Simla, 1898, Hb. No. 11086 d (BM). Meghalaya—Shillong, Panigrahi 3326 (AWAS); Laitkar forest, alt. 1650 m, on bark, AWASTHI 6002, 6436 (AWAS)—fertile; Mawlai, alt. 1500 m, over hard soil, AWASTHI 7906 A (AWAS)—isidia dense, branched; Mawmai area, 7 km from Cherrapunjee, alt. 1100 m, on bark, AWASTHI 7933 (AWAS); Shillong to Jowai route, Mawryngkneng, on Pine bark, AWASTHI 8005 (AWAS), Thadlaskien Lake, on Pine bark, AWASTHI 8027 B (AWAS); Khasya hills, 1874, Griffith 309 (BM). Sikkim—Jongri, BOSE 6336 (AWAS)—fertile, lobes up to 20 mm wide, det. KUROKAWA; no precise loc. HOOKER 2007 pr. p. (BM)—mixed with *Cetraria thomsonii* (Stirt.) Müll Arg. Tamil Nadu—Nilgiri hills, Kodanad tea estate, on bark, AWASTHI & SINGH 70.1503 (LWU); Kodanad, in Shola, on tree bark, SINGH 71.1031 (LWU); Kotagiri to Kodanad, on tree bark, SINGH 71.924 (LWU); Mettupalayam Road from Coonoor, on bark, SINGH 71.857 (LWU); Naduvattam, on

Cinchona tree, SINGH 72.67, 72.85 (LWU); Sholurmatta, near Kilkotagiri, alt. 1600 m, on tree bark, SINGH 71.906 (LWU); Palni hills, Kodaikanal, Bear Shola, alt. 2100 m, on tree trunk, AWASTHI & SINGH 70.19 (LWU); Pillar Rocks area, alt. 2250 m, on bark, AWASTHI & SINGH 70.265 (LWU)—fertile; Golf Club area, SINGH 70.606, 70.794 (LWU); Pambampuram, on bark of tree, SINGH 70.576 (LWU); Shembaganur, alt. 1800 m, on peach tree bark, SINGH 70.863 (LWU); Booparai area, alt. 1800 m, on tree trunk, SINGH 70.1135 (LWU)—fertile; Fairy Falls, on tree, SINGH 70.1223 (LWU); near Volagiri, alt. 1100 m, on orange tree bark, SINGH 70.1243 (LWU); on way to Kuranjiandvar temple, alt. 1800 m, SINGH 70.1297 (LWU); Perumal Coffee plantation, on tree trunk, SINGH 70.1111 (LWU); Shembaganur, on tree, FOREAU 3741, 4087, 4088 (AWAS)—det. HALE; AWASTHI 4257 (AWAS)—det. HALE. Uttar Pradesh—Almora district, Ranikhet to Chaubattia, over stones, AWASTHI 3529 (AWAS); Dehradun district, Mussoorie, AWASTHI 3814 (AWAS); Joshi 75.356 (LWU); Chakrata, on tree trunk of *Cedrus deodara*, AWASTHI & JOSHI 76.27 (LWU); Pithoragarh district, Askote, AWASTHI (over stones) 3322, 3936 (on *Rhododendron* bark) and fertile (AWAS); Digtarh, on tree trunk, AWASTHI 3980, 6434 (AWAS); Uttarkashi district, Kukinkhal, alt. 3000 m, Swami PRANAVANAND 4027 (AWAS); Nainital district, near Tanakpur, alt. 300 m, on tree trunk, AWASTHI 3175 (AWAS); Almora district, Loharkhet to Dhakuri, alt. 2250 m, over stones, AWASTHI & AWASTHI 603 (AWAS); Jageshwar, alt. 1800 m, AWASTHI 3509 (AWAS)—det. KUROKAWA; Dwali Khati, over stones, AWASTHI 7630 (AWAS). West Bengal—Darjeeling district, Tiger hill, alt. 2550 m, on tree trunk, AWASTHI & AGARWAL, 67.22 (LWU); Kurseong, alt. 1600 m, on tree trunk, AWASTHI & AGARWAL 66.172 (LWU); near Mahanadi, alt. 1200 m, on tree trunk, AWASTHI & AGARWAL, 66.299 (LWU); Chinabhatti to Tindharia, alt. 750 m, on tree, AWASTHI & AGARWAL 66.121, 66.122 (LWU); near Lebong, alt. 1650 m, AWASTHI & AGARWAL 67.230 (LWU)—fertile; Senchal, near lake, alt. 2100 m, AWASTHI (AWAS); Dow hill, near Kurseong, on tree, AWASTHI & AGARWAL 66.252 (LWU)—fertile; Kalimpong, on way to Munsong, over stones, AWASTHI & AGARWAL 67.329 (LWU); Munsong, on *Cinchona* bark, AWASTHI & AGARWAL 67.287 B (LWU), Darjeeling, Bot. Garden, AWASTHI 3837 (AWAS).

Extra-Indian specimens examined:

Nepal—E. Nepal, Mewakhola valley, alt. 1500 m, over rock by road side, AWASTHI 2203 (AWAS) — fertile, det. KUROKAWA; alt. 1350 m, over boulder, AWASTHI 2198 (AWAS); above Phidim, over stones, AWASTHI 2156, 2157 (AWAS); Nigala village, alt. 1900 m, ROLLA RAO 13563 (AWAS). Sri Lanka—No precise loc., Thwaites 33 b, pr. p. (BM).

The taxon has been reported from several localities in E. Himalayas and Nepal by KUROKAWA (1966, p. 610).

67. *Parmelia xantholepis* Mont. & v. d. Bosch

In Jungh. *Plant. Funghuhn* : 446, 1855; Zahlbr. *Cat. Lich. Univ.* 6:222, 1930.

Parmelia xantholepis (Mont. & v. d. Bosch) Hale, *Phytologia*, 28: 483, 1974.

Plate 5, Fig. 6

Thallus corticolous, foliose, closely adnate to substratum, 3-4 cm in diameter, mineral grey to grey, lobes dimorphic, primary lobes 2-4 mm wide usually distinct in peripheral area, secondary lobes suberect, developing from the margin of primary lobes, dichotomously branched, linear lobulate, 0.5-1.5 mm wide, much imbricate and superposing the primary lobes, ends rounded, margin with short cilia generally at the axils; upper surface \pm smooth shining to rugulose; isidia and soredia absent; lower side black, densely rhizinate, a narrow marginal zone brown with rhizinal papillae; rhizinae simple to squarrose branched; medulla yellow. Apothecia absent in the specimens examined.

Thallus K+yellow; medulla K—, C—, KC—, P—.

Parmelia xantholepis is distinctive in the development of dimorphic lobes, the secondary lobules being narrow and dense. The taxon does not show any resemblance to other species of the genus in India. It is distributed in the subtropical to temperate regions.

Specimens examined:

Tamil Nadu—Palni hills, Penneikodu, alt. 1275 m, on bark, FOREAU 4118 (AWAS)—det. HALE. West Bengal—Darjeeling district, Darjeeling Bot. Garden, alt. 1950 m, on tree trunk, AWASTHI 3839 (AWAS)—det. HALE, 1965; Kurseong, Dow Hill, alt. 1700 m, on bark of tree, AWASTHI & AGARWAL 66.266 (LWU).

The taxon has also been reported from Darjeeling by KUROKAWA (1966, p. 610).

Subgenus **Amphigymnia** (Vain.) Dodge

Ann. Miss. Bot. Gard. 46: 114, 1959; Hale, *Contr. U. S. Nat. Herb.* 36: 193—358, 1965.

Parmelia sect. *Amphigymnia* Vain. *Étud. Lich. Brésil.* 1 28, 1890.

Parmelia subg. *Euparmelia* sect. *Amphigymnia* (Vain.) Zahlbr. in Engl. Prantl, *Naturl. Pflazenfam.* 1(1): 213, 1907, and 2 ed. Bd. 8: 235, 1926.

Parmotrema Mass. in Atti. I. R. Istit. Veneto, ser. 3, 5:248, 1860; Hale, *Phytologia*, 28: 334-339, 1974.

The subgenus *Amphigymnia* is characterized by mineral grey to grey (rarely yellow grey) thallus with broad rotund lobes, rhizinae on lower side are sparse, usually simple, and restricted in the central part of the thallus, a broad marginal zone is erhizinate and shining. Apothecia generally stipitate to pedicellate, and often perforated in the centre, the spores generally larger than in subgenus *Parmelia*.

In few taxa the rhizinae occur distributed right up to the margin either in the form of, rhizinae or as rhizinal papillae. Mention may be made of *Parmelia subtinctoria*, *P. reticulata* *P. subsumpta*, etc. some of which had been treated under the subgenus *Parmelia*, but the broad lobed condition associated with elongated marginal cilia and perforated apothecia make them more closely related to the *Amphigymnias* rather than to members of subg. *Parmelia*. In all such cases I have included the disputed taxa in the keys both of subg. *Parmelia* and subg. *Amphigymnia*, while the detailed description is given under the subgenus referred to.

KEY TO THE INDIAN SPECIES OF SUBG. *AMPHIGYMNIA*

1a—Thallus isidiate

2a—Margin of lobes ciliate

3a—Lower side rhizinate papillate up to the margin

4a—Upper side maculate, cilia long, all along the margin.....31. *P. subtinctoria*

4b—Upper side emaculate, cilia short, usually at axils of lobes.....*P. wallichiana*
(see under subg. *Parmelia*)

3b—Lower side erhizinate along margin

5a—Medulla K+ yellow turning red.....*P. wallichiana*
(see under subg. *Parmelia*)

5b—Medulla K— or + yellow

6a—Thallus grey, medulla P+orange.....7. *P. crinita*

6b—Thallus yellowish grey or yellow green, medulla P—34. *P. xanthina*

2b—Margin of lobes eciliate

7a—Medulla K+, red, rhizinae dichotomously branched..... *P. awasthii*
(see under subg. *Parmelia*)

7b—Medulla K—

8a—Medulla G + red..... 32. *P. tinctorum*

8b—Medulla G—, P + red..... 26. *P. saccatiloba*

1b—Thallus lacking isidia

9a—Thallus pustulate-sorediate or sorediate

10a—Margin of lobes ciliate

11a—Medulla K+ yellow turning red

12a—Upper side maculate, lower side rhizinate-papillate up to the margin

13a—Maculae reticulate, and upper side reticulately cracked

rhizinae branched25. *P. reticulata*

13b—Maculae not reticulate, rhizinae simple

14a—All lobes rotund, adnate.....30. *P. subsumpta*

14b—Erect to suberect lobules from the margin.....18. *P. margaritata*

12b—Upper side emaculate, lower side erhizinate along margin,

medulla C—, KC—, P+orange..... 28. *P. stuppea*

- 11b—Medulla K—
 15a—Medulla P+red
 16a—Cilia along the lobe margins dense and long.....29. *P. subarnoldii*
 16b—Cilia sparse along lobe margins, generally present at axil.....9. *P. dilatata*
 15b—Medulla P—
 17a—Medulla C+rose or red
 18a—Upper side maculate, lecanoric acid present.....6. *P. cooperi*
 18b—Upper side emaculate, gyrophoric acid present
 19a—Lobes large, marginal area along lower side ivory
 to pale brown, medulla if pigmented, pigment
 K+purple 27. *P. sancti-angelii*
 19b—Lobes smaller, marginal area on lower side brown,
 medulla pigmented in lower part, pigment K—..... 21. *P. permutata*
 17b—Medulla C—
 20a—Medulla KC+red
 21a—Upper side maculate
 22a—Marginal area on lower side dark brown..23. *P. pseudonilgherrensis*
 22b—Marginal area on lower side ivory to pale grey.... 16. *P. hababiana*
 21b—Upperside emaculate
 23a—Rhizinae simple, thallus large lobed
 24a—Soredia on marginal isidioid growths..... 19. *P. mellissii*
 24b—Marginal isidioid growth absent, soralia
 directly on the margin
 25a—Soralia P+yellow to deep yellow.....10. *P. direagens*
 25b—Soralia P— 24. *P. ramphoddensis*
 23b—Rhizinae dimorphic, thallus small lobed
 26a—Soralia P+yellow to deep yellow..... 10. *P. direagens*
 26b—Soralia P— 35. *P. yodae*
 20b—Medulla KC—
 27a—Upper side maculate, lower side with broad ivory
 zone along margin, corticolous..... 16. *P. hababiana*
 27b—Upper side emaculate, lower side brown black
 along margin, saxicolous..... 15. *P. grayana*
 10b—Margin of lobes eciliate
 28a—Thallus mineral grey to grey (usnic acid absent)
 29a—Medulla K+red, P+red
 30a—Upperside maculate-reticulate and reticulately cracked.... 25. *P. reticulata*
 30b—Upperside emaculate, smooth..... 8. *P. cristifera*
 29b—Medulla K—
 31a—Medulla P+red, KC+rose..... 9. *P. dilatata*
 31b—Medulla P—
 32a—Medulla C+red, KC+red..... 3. *P. austro-sinensis*
 32b—Medulla C—, KC—..... 22. *P. praesorediosa*
 28b—Thallus yellow green to yellow grey (usnic acid present)
 33a—Medulla C+red
 34a—Upper side pseudocyphellate..... 14. *P. flaventior*
 34b—Upper side without pseudocyphellae..... 33. *P. ulophyllodes*
 33b—Medulla C—, P+red.....4. *P. caperata*
 9b—Thallus lacking pustules and soredia
 35a—Margin of lobes ciliate
 36a—Medulla C+red or rose-red
 37a—Upper side indistinctly maculate, medulla C+rose red,
 gyrophoric acid present..... 13. *P. euneta*
 37b—Upper side emaculate, medulla C+red, lecanoric acid present.... 12. *P. erhizizosa*
 36b—Medulla C—, KC+red or reddish
 38a—Upper side densely maculate, thallus large,..... 20. *P. nilgherrensis*
 38b—Upper side emaculate, thallus smaller..... 1. *P. abessinica*

35b—Margin of lobes eciliate

39a—Medulla K+red or red brown

40a—Upper side reticulately maculate, spores $13-17 \times 6-18 \mu\text{m}$ 5. *P. cetrata*

40b—Upper side emaculate, spores $28-32 \mu\text{m}$ long..... 17. *P. latissima*

39 —Medulla K—

41a—Medulla P+orange red, margins lacinate, upper side maculate .. 11. *P. disparalis*

41b—Medulla P—, C+red, lecanoric acid present.....2. *P. andina*

1. *Parmelia abessinica* Kremp.

Linnaea, 41; 140, 1877; *Zahlbr. Cat. Lich. Univ.* 6: 223, 1930; *Hale, Contr. U. S. Nat. Herb.* 36: 320, 1965.

Parmotrema abessinicum (Kremp.) Hale, *Phytologia*, 28: 334, 1974.

Plate 15, Fig. 4

Thallus corticolous, rarely saxicolous, foliose, loosely adnate to substratum, 5-7 cm in diameter, grey to grey brownish; lobes rotund, up to 10 mm wide, margin crenate, ciliate; cilia 1-3 mm long, simple; upper surface smooth, faintly or indistinctly maculate; isidia and soredia absent; lowerside minutely wrinkled, brown black, sparsely rhizinate in the central part, marginal narrow zone light brown to mottled pale brown, erhizinate; rhizinae simple; medulla white. Apothecia stipitate, 4-6 mm in diameter, perforated; disc brown, smooth, amphithecium rugose, maculate; asci 8 spored; spores colourless, simple, ovoid, $18-22 (25) \times 9-13 \mu\text{m}$.

Thallus K+yellow; medulla K—, C—, KC+reddish, P—; atranorin, [norlobaridone, loxodin and protolichesterinic acid present (WINNEN, 1975)]

Parmelia abessinica has a comparatively smaller thallus than *P. nilgherrensis* with narrower lobes, faint maculae and mottled underside at the margin. It is mainly distributed in tropical Africa, and is of rare occurrence in India.

Specimen examined:

Tamil Nādu—Madras, Bellary district, on rocks, 1886, BROUGHAM (BM).

2. *Parmelia andina* Müll. Arg.

Rev. Mycol. 1:169, 1879; *Zahlbr. Cat. Lich. Univ.* 6: 239, 1930 (subg. *P. hildebrandtii* var. *nuda*); *Hale, Contr. U. S. Nat. Herb.* 36: 236, 1965.

Parmotrema andinum (Müll. Arg.) Hale, *Phytologia*, 28: 334, 1974.

Parmelia mallii Räs. *Arch. Soc. Zöll. Bot. Fenn.* 'Vanamo', 6(2): 81, 1951.

Plate 14, Fig. 4

Thallus corticolous, foliose, loosely adnate to substratum, \pm soft, up to 15 cm in diameter, ashy white to grey, (greenish when collected); lobes rotund, 8-12 mm wide, ascending; margin crenate, eciliate; isidia and soredia absent; upper surface smooth, faintly to distinctly maculate, \pm cracked in older part; lowerside minutely wrinkled, black, sparsely shortly rhizinate in the central part, marginal 4-5 mm wide zone erhizinate, brown to light tan and shining; medulla white. Apothecia present in all specimens, shortly stipitate, up to 15 mm in diameter, imperforate or perforated at centre, disc brown, smooth, amphithecium rugose, maculate; hymenium $90-100 \mu\text{m}$ high; asci 8 spored; spores colourless, simple, oval ellipsoid, $15-20 \times 8.5-12 \mu\text{m}$; pycnidia often present.

Thallus K+yellow; medulla K—, C+bright red, KC+bright red, P—; atranorin and lecanoric acid present.

Parmelia andina is easily distinguished by the nonisidiate, non-sorediate thallus, eciliate margin and presence of lecanoric acid (medulla C+red), and is almost always fertile. It is widely distributed in S. Central Africa, S. America and Asia, and is also well represented in different parts of India.

Specimens examined:

Bihar—Morabadi hill, on *Pongamia glabra* bark, alt. 750 m, AWASTHI 28 (AWAS). Madhya Pradesh—Pendra Road, White House, on tree, MACKENZIE 455 (AWAS); Saugor, on *Pongamia glabra* bark, 1949, MALL 446 (AWAS)—isotype of *Parmelia mallii* Räs., revised HALE, 1967. Orissa—6 km from Palaspal towards Ribna, on twigs, PANIGRAHI 8519 (AWAS). Tamil Nadu—Palni hills, Shembaganur, alt. 1800 m, on *Acrocarpus* tree, FOREAU 4175, 4176 (AWAS)—det. Hale; on pear tree, SINGH 70.850 (LWU); S. H. College, AWASTHI 4255 (AWAS)—det. Hale. Uttar Pradesh—Dehradun district, Mussoorie, Landour, alt. 2100 m, 1952, HÖEG 3405 (AWAS)—det. Hale,—thallus small, rugulose wrinkled in central part, apothecia imperforate.

3. ***Parmelia austrosinensis*** Zahlbr.

Symb. Sin. 3: 192, 1930; *Cat. Lich. Univ.* 8: 554, 1932; Hale, *Contr. U. S. Nat. Herb.* 36: 238, 1965.

Parmotrema austrosinense (Zahlbr.) Hale, *Phytologia* 28: 335, 1974.

Plate 10, Fig. 4

Thallus mostly corticolous, rarely saxicolous, foliose, loosely attached to substratum, soft to touch, up to 10 cm in diameter, glaucous white to grey; lobes rotund, 10–12 (20) mm wide; margins ascending, imbricate, sinuous, eciliate; upper surface smooth, emaculate to faintly maculate, marginally sorediate; soralia linear, sinuous, much wavy and continuous for few centimeters in length; soredia fine, farinose; lower side finely reticulately wrinkled, black, sparsely rhizinate in central part, marginal 4–6 mm wide zone erhizinate, yellowish brown, light tan to white mottled, dull or \pm shining; medulla white. Apothecia rare, shortly stipitate, up to 5 mm in diameter, perforated; disc concave, brown; amphithecium smooth to maculate; hymenium 50–75 μ m high; asci 8 spored; spores colourless, simple, ovoid ellipsoid, 12–16 \times 6–8 μ m.

Thallus K+yellow; medulla K–, C+rose-red, KC+red, P–; atranorin and lecanoric acid present.

Parmelia austrosinensis is rather characteristically foamy soft to touch and this character alone may distinguish it from other sorediate species in the group except *P. hababiana*. It resembles *P. sancti-angelii* and *P. hababiana* in the sorediate condition, and sometimes they also grow together. But *P. sancti-angelii* is coriaceous, margins are ciliate, soredia are granular and possesses gyrophoric acid; *P. hababiana* is also somewhat soft to touch, but has cilia along margin and medulla is C–, P+red. *Parmelia austrosinensis* is widely distributed in tropical Africa and S. America, and is also well represented in India.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Himachal Pradesh—Solan, comm. SESHADRI 3733 (AWAS). Karnataka—Mysore, on twigs, AWASTHI 3587 (AWAS)—det. HALE. Meghalaya—Khasia hills, Nunklow, HOOKER & THOMSON 1986 (BM)—pr. p. *P. tinctorum*. Tamil Nadu—Palni hills, Perumal coffee plantation, alt. 1500 m, AWASTHI 4346 (AWAS); Shembaganur, S. H. College, alt. 1800 m, on *Acrocarpus fraxinifolius* bark, FOREAU 4172 (AWAS); on tree twigs, AWASTHI 4264 (AWAS)—det. Hale. Uttar Pradesh—Almora district, Almora, on vertical side of stone wall in shady place, AWASTHI 3519 (AWAS); Takula, alt. 1800 m, on tree twigs, AWASTHI & AWASTHI 576 (AWAS); Ranikhet to Ghaubattia, alt. 2100 m, on twigs of shrubs, AWASTHI 3548 (AWAS)—pr. p. *P. hababiana*, det. Hale; Pithoragarh district, Askote, on tree trunk, AWASTHI 3317 A, 3297 (pr. p. *P. hababiana*) (AWAS)—det. HALE; Dhanlek, alt. 1650 m, on twigs of shrubs, AWASTHI 3961 (AWAS)—fertile; Askote to Digtarh, alt. 1650 m, on twigs of shrubs and trees, AWASTHI 3990 (AWAS)—fertile; Dehradun district, Chakrata, alt. 1800m, AWASTHI & JOSHI 76.40 B (LWU).

Extra-Indian specimen examined:

Nepal—E. Nepal, Phenikhola valley, alt. 1500 m, AWASTHI 2185 (AWAS).

4. ***Parmelia caperata*** (L.) Ach.

Meth. Lich. 216, 1803; Zahlbr. *Cat. Lich. Univ.* 6: 227, 1930; Hale and Kurokawa, *Contr. U. S. Nat. Herb.* 36: 149, 1964.

Plate 9, Figs. 5 & 6

Thallus corticolous or saxicolous, foliose, loosely to closely adnate to substratum, thick, coriaceous, 10-20 cm in diameter, greenish yellow, yellow grey to darker; lobes rotund, up to 10 mm wide, ascending imbricate to confluent, margin entire to crenate, eciliate; upper surface smooth at peripheral parts, \pm longitudinally plicate rugose towards centre, pustulate, pustules mostly on ridges, developing into laminal soralia which are discrete or are confluent later; soredia granular; lower side rough, black, sparsely rhizinate throughout the surface, marginal 2-3 mm wide zone light tan to brownish, erhizinate, smooth shining or with yellowish or pale grey rhizinate papillae; rhizinae short, simple, pale brown to black; medulla white. Apothecia very rare (seen in a single specimen), up to 3 mm in diameter, constricted at base, imperforate; disc brown, smooth; amphithecium rugose sorediate; hymenium 50-68 μ m high; asci 8 spored; spores 15-20 \times 7-10 μ m.

Thallus K—; medulla K—, C—, KC—, P+orange red; usnic, protocetraric and caperatic acids present.

Parmelia caperata is rather distinctive in the large lobed, greenish yellow to yellow grey thallus, pustulate-sorediate upper surface and medulla P+orange red. It is mostly distributed in the dry temperate regions of the world. It had been placed in sect. *Amphigymnia* by ZAHLBRUCKNER (1930), was considered a member of subg. *Parmelia* by HALE and KUROKAWA (1964) and recently transferred to genus *Pseudoparmelia* by HALE (1974 d).

Specimens examined:

Unless stated otherwise the specimens are sterile.

Himachal Pradesh—Chhika alt. 1800 m, HÖEG 1779 (AWAS)—det. Kurokawa; Manali, alt. 1800 m, on *Cedrus deodara* trunk, AWASTHI & DANGE 70.012 (LWU); AWASTHI *et al.* (LWU); Parbati river valley, near Manikaran, alt. 1650 m, AWASTHI & DANGE, 75.049, 75.050, 75.088 A (LWU); near Pulga, alt. 2100 m, on coniferous tree trunks, AWASTHI & DANGE, 75.104 A, 75.165, 75.169 A (LWU); Pulga to Bhandag alt. 2400—2800 m, on Pines, AWASTHI & DANGE 75.281 (fertile), 75.294 (LWU); Kheer Ganga, alt. 3150 m, fallen off tree, AWASTHI & DANGE 75.319 (LWU); Simla, on *Cedrus deodara*, AWASTHI 1422 (AWAS); leg. no. 11086 G (BM). Jammu & Kashmir—Pahalgam, alt. 2250 m, on tree, AWASTHI *et al.* (LWU); Sonamarg, alt. 2100 m, on tree, AWASTHI *et al.* (LWU). Meghalaya—No precise locality. BHATT 3386 (AWAS). Tamil Nadu—Nilgiri hills, Emerald road, on tree, SINGH 73.476 (LWU); Kilkotagiri to Konada, on tree, AWASTHI & SINGH 71.2 (LWU); Kotagiri to Kodanad, alt. 1800 m, on tree, SINGH 71.936 (LWU); Ootacamund Bot. Garden, alt. 2100 m, on tree trunk, AWASTHI 4452 (AWAS); Sholurmatta, alt. 1500 m, on tree, SINGH 71.909 (LWU); Palni hills, Kodaikanal, alt. 2100 m, HÖEG 2516 (AWAS)—det. HALE; FOREAU 4091 (AWAS); Bryant Park, on tree, SINGH 70.1053 (LWU); Golf Club area, on tree, SINGH 70.637 (LWU); Pillar Rocks area, on tree, alt. 2250 m, AWASTHI & SINGH 70.280 (LWU); SINGH 70.682 (LWU); Kodaikanal to Berijam road, alt. 2250 m, on tree, FOREAU & AWASTHI 4237 (AWAS); Sirudamkanal Shola, on trunk of *Rhododendron*, FOREAU 4547 (AWAS); Shembaganur, on tree, FOREAU 3744 (AWAS)—det. Hale. Uttar Pradesh—Almora district, Jageshwar, on Pine tree trunk, AWASTHI 3515 (AWAS); Kasardevi, alt. 1800 m, on Pine tree trunk, AWASTHI 3442 (AWAS); Ranikhet to Chaubattia, alt. 1800 m, on bark, AWASTHI 3530 (AWAS); TEWARI (AWAS); Almora to Takula, alt. 1650 m, over rocks and ground, AWASTHI & AWASTHI 560 (AWAS); Dehradun district, Chakrata, alt. 2100 m, on tree trunk, AWASTHI 496 (AWAS); AWASTHI & JOSHI 76.26, 76.95, 76.178 (LWU); Pithoragarh district, Gori river valley, alt. 1800 m, on rock in shade, AWASTHI 824 (AWAS).

Extra-Indian specimens examined:

Nepal—Thyanbocke from Namchabazar, alt. 2743 m, ROLLA RAO (AWAS). Pakistan—Thandiani, alt. 2700 m, on tree trunk, MC VEAN 60.6 (AWAS).

5. *Parmelia cetrata* Ach.

Synop. Lich. 198, 1814; Zahlbr. *Cat. Lich. Univ.* 6: 160, 1930; Hale & Kurokawa, *Contr. U. S. Nat. Herb.* 36:129, 1964.

Plate 15, Fig. 1

Thallus corticolous or saxicolous, foliose, loosely adnate to substratum, 15-20 cm in diameter, mineral grey to pale grey, laciniate lobate, lobes rotund, up to 10 mm wide, irregularly crenate-dentate and sinuate with microphylline lacinules along the lateral margins in the central part of the thallus, lacinules subdichotomously divided, tapering 2-1 mm wide, 1-3 mm long, margin distinctly ciliate, cilia 0.5-2 mm long; upper surface dull, smooth, densely maculate and reticulately cracked, more so in the central part; isidia and soredia absent; lowerside black, densely rhizinate up to the margin, marginal 2-3 mm wide zone shining, papillate; rhizinae simple to squarrosely branched; thallus ca. 150 μ m thick; medulla white. Apothecia plentiful, shortly stipitate, up to 10 mm in diameter, concave to plane, perforate; disc brown, shining; amphithecium rugose; hymenium 68-80 μ m high; epithecium brown; asci 8 spored; spores colourless, simple, oval, 13-17+6 \times 10 μ m.

Thallus K+yellow; medulla K+red to red brown, C-, P+orange red; atranorin and salacinic acid present.

Parmelia cetrata had been placed in subg. *Parmelia* sect. *Irregulares* by HALE & KUROWAKA (1964), but recently HALE (1974) revised his opinion and placed the taxon in *Parmotrema* along with other Amphigymnias. I have followed this latter concept of placing *P. cetrata* along with other Amphigymnias as it is a counter part of the sorediate *P. reticulata* which also is placed in Amphigymnia by me, though that taxon has not been placed in *Parmotrema* by HALE. The taxon is widely distributed in the pantropical regions, and though it has not been collected from India as yet, but may possibly occur in southern part of India.

Extra-Indian specimen examined:

Sri Lanka—(Ceylon), Punduloya, 1889, on rocks, GREEN (BM)—det. HALE.

6. ***Parmelia cooperi*** Stein & Zahlbr.

In *Engl. Bot. Jahrb.* 60: 528, 1926; Zahlbr. *Cat. Lich. Univ.* 6:235, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 323, 1965.

Plate 11, Fig. 3

Thallus corticolous, foliose, loosely attached to substratum, large, generally convoluted, mineral grey to grey; lobes dimorphic, generally rotund up to 20 mm wide, some lobes flabellate-rotund and up to 40 mm wide; margins irregularly convolute, ciliate; cilia black, simple to once or twice bifurcated, 2-3 mm long; upper surface smooth, maculate, reticulately cracked in older parts; soralia marginal to submarginal, linear, sinuous; sorediate lobes involute; lower side reticulately minutely wrinkled, black and sparsely rhizinate in the central region, marginal 4-6 mm wide zone erhizinate, pale brown to yellowish, smooth; rhizinae bifurcated like the cilia; medulla white. Apothecia absent in the specimens examined.

Thallus K+yellow; medulla K-, C+red, KC+red, P-; atranorin and lecanoric acid present.

Parmelia cooperi is distinctive in its wide dimorphic lobes with a wide yellowish brown zone along the margin on lower side. This light coloured marginal zone corresponds to that of *P. austro sinensis* which also has lecanoric acid, but the margins of *P. austro sinensis* thallus are eciliate, upper surface emaculate. The dimorphic lobes show a parallel development in *P. erhizinos*a Awasthi, which is non-isidiate and non-sorediate, and lacks rhizinae. It is likely that the two are counter species with esorediate condition in *P. erhizinos*a and

sorediate condition in *P. cooperi*. *P. cooperi* is known from tropical Africa and is being reported for the first time from India.

Specimens examined:

Tamil Nadu—Palni Hills, Shembaganur, alt. 1800 m, on trees, FOREAU 4090 B (AWAS)—det. HALE, 1965; Same loc. 1964, DEGELIUS (DEGEL); Kodaikanal, on trees, Degelius As- 264, As-353 (DEGEL).

7. ***Parmelia crinita* Ach.**

Synop. Lich. 196, 1814; *Zahlbr. Cat. Lich. Univ.* 6: 236, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 284, 1965.

Thallus corticolous, rarely over mosses on ground, foliose, loosely attached to substratum 4-8 cm in diameter, grey to darker grey; lobes rotund, up to 10 mm wide, marginally crenate and ciliate; cilia black, simple to forked, 1-2 mm long; upper surface smooth, dull, emaculate, densely isidiate, \pm shining at periphery; isidia laminal, up to 1 mm thick, simple to coralloid branched, and often apically ciliate; lower side slightly rugose, black and uniformly rhizinate in the greater central part, marginal 2-4 mm wide zone erhizinate, shining tan; rhizinae simple, sometimes rhizinate papillae inside the marginal zone; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K—, C—, KC—, P+orange yellow; atranorin and stictic acid present.

K+Y

Parmelia crinita shows a close resemblance to *P. subtinctoria*, especially when the latter has a brown black underside; *P. crinita* is then distinguished by thickish isidia and medulla K—, P+orange yellow reaction. The taxon is widely distributed from tropical to temperate areas in the world and is so far known from the hills of S. India only. The taxon has not been referred to *Parmotrema* by HALE (1974 a).

Specimens examined:

Tamil Nadu—Nilgiri hills; Ootacamund to Kotagiri road near Doddabetta tea estate, alt. 2100 m, SINGH 71.1041 (LWU); 3 km from Doddabetta, alt. 2250 m, on ground over mosses, SINGH 11.4 (LWU); Palni hills; Hill View below Perumalmalai, alt. 1300 m, on tree trunk, AWASTHI & SINGH 70.402 A (LWU); Kodaikanal to Berijam road, in shola at 14 Km, alt. 2250 m, on tree trunk, FOREAU & AWASTHI 4239 (AWAS)—det. HALE, 1965; Shembaganur, Perumal Coffee plantation, alt. 1590 m, AWASTHI 4344 (AWAS)—det. HALE, 1963.

8. ***Parmelia cristifera* Tayl.**

Lond. J. Bot. 6: 165, 1847; *Zahlbr. Cat. Lich. Univ.* 6: 237, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 241, 1965.

Parmotrema cristiferum (Tayl.) Hale, *Phytologia*, 28: 335, 1974.

Parmelia mesotropa f. *sorediosa* Müll. *Arg. Flora*, 74: 377, 1891.

Plate 10, Fig. 3

Thallus corticolous, foliose, loosely attached to substratum, large, spreading, coriaceous up to 22 cm in diameter, mineral grey to pale grey, marginal area in central part brownish black; lobes rotund, 10-15 mm wide, laterally ascending, sinuous and \pm imbricate; margin entire, eciliate; upper surface dull, smooth, emaculate, marginally sorediate in central part; soralia rounded to crescent shaped to confluent sinuous and revolute; soredia \pm granular; lower side smooth to faintly rough, black, sparsely rhizinate in the central part, marginal about 10 mm wide zone erhizinate, brown or tan coloured; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K+red, C—, P+orange; atranorin and salacinic acid present.

Parmelia cristifera is easily distinguished by large rotund lobes without cilia, marginally sorediate and presence of salacinic acid. The species is based on a specimen collected by WALLICH from Calcutta and preserved in Farlow herbarium (FH—Tayl.). The

taxon is widely distributed in the pantropical parts of the world eastwards to Pacific and America, but is known from India from few localities, and has not been collected again from Calcutta. Its absence in Calcutta region indicates that apparently there has been a marked climatic change in the environs of Calcutta since WALLICH's (early 19th century) time.

Specimens examined:

Arunachal Pradesh—(N.E.F.A.) Rahung, alt. 1650 m, on *Rhododendron arboreum* tree, ROLLA RAO 7502 (AWAS, SHILLONG). Bihar—Chhota Nagpur, Rangangara, alt. 750 m, on twig, AWASTHI 40 (AWAS). West Bengal—Darjeeling district, Rangit River valley, alt. 1000 m, on tree bark, AWASTHI & AGARWAL 67.217 (LWU). Orissa—Bhanjabasa, alt. 700 m, on twigs, PANIGRAHI 12351 (AWAS)—pr. p.+*P. sancti-angelii*.

Extra-Indian specimens examined:

Himalaya—Penang hills, GRIFFITH (BM)—thallus 22 cm in diam.; Dewangui, alt. 3600 m, leg? (BM).

9. ***Parmelia dilatata* Vain.**

Acta Soc. Faun. Fl. Fenn. 7(7): 33, 1890; *Zahlbr. Cat. Lich. Univ.* 6: 238, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 245, 1965.

Parmotrema dilatatum (Vain.) Hale, *Phytologia* 28: 335, 1974.

Plate 10, Fig. 6

Thallus corticolous, foliose, loosely attached to substratum, \pm coriaceous, 4-10 cm in diameter, mineral grey to darker grey; lobes rotund, (4) 6-10 mm wide, longitudinally \pm lacerate, lateral margins ascending, \pm imbricate and divided, crenate and sparsely ciliate; cilia generally in the axils of dents, and in sorediate parts, apices of main lobes usually eciliate; upper surface smooth, dull, emaculate to faintly maculate; soralia marginal on apices of dentate lobules, globular or confluent, linear; lower side minutely wrinkled, black, sparsely rhizinate in the central part, marginal zone erhizinate, tan to yellowish brown or white mottled and shining; rhizinae simple, short; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K—, C—, KC+reddish, P+red, soralia P+red; atranorin and protocetraric acid present.

Parmelia dilatata externally resembles *P. cristifera*, but is distinguished by the presence of sparse cilia and negative K reaction in medulla. HALE (1965) reports that exceptionally there may be cilia in *P. cristifera* as well, and in that case the K reaction will distinguish the two. *Parmelia subarnoldii* is also close to *P. dilatata*, but has dense cilia on the margin of the main lobes as well. *P. dilatata* is widely distributed in pantropical America and Africa and is of rare occurrence in India.

Specimens examined:

Kerala—Quilon, on tree, HÖEG 2573 (AWAS)—det. HALE c.f. *P. dilatata*: on way to Kuri 5 km to Kotrakara, on *Tectona* tree, SINGH 73.235 (LWU)—cilia extremely rare. Tamil Nadu—Palni hills, Kodaikanal, Pillar Rocks area, alt. 2250 m, on tree trunk, AWASTHI & SINGH 70.199 (LWU)—pr. p.+*P. reticulata*. N.W. Himalaya—No precise locality, 1931, STEWART (BM).

Extra-Indian specimen examined:

Sri Lanka—(Ceylon), Central Provinces, THWAITES 33 (BM).

10. ***Parmelia direagens* Hale**

Contr. U. S. Nat. Herb. 36: 288, 1965.

Parmotrema direagens (Hale) Hale, *Phytologia*, 28: 335, 1974.

Plate 13, Fig. 4

Thallus corticolous, rarely saxicolous, foliose, loosely attached to substratum, 10-15 cm in diameter, grey; lobes 10-20 (30) mm wide, rotund, margins \pm imbricate, entire to crenate, sinuous, sparsely or densely ciliate; upper surface smooth, emaculate to faintly maculate; soralia marginal, linear, subcontinuous to continuous, sinuous; lower side minutely wrinkled, black, sparsely rhizinate in the central part; marginal 3-5 mm wide zone erhizinate, mottled ivory to brownish, shining; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K—, C—, KC+pinkish red, P—; soralia P+yellow to deep yellow (holotype contains atranorin, alectoronic, gyrophoric and psoromic acids according to WINNEM, 1975)

Parmelia direagens very closely resembles *P. rampoddensis* in general morphology, the only clearly distinguishing character is the P+reaction in soralia and the presence of gyrophoric and psoromic acids.

Specimens examined:

Tamil Nadu—Nilgiri hills; Emerald road, Fern Hill, over stones, SINGH 73.496 (LWU); Ootacamund Botanic Garden, alt. 2100 m, on tree, AWASTHI 4447 (AWAS); Ootacamund to Kotagiri route, near Doddabetta tea estate, alt. 2100 m, on tea plants, SINGH 71.1040 (LWU); Palni hills; Kodaikanal, AWASTHI & SINGH 70.1 (LWU); Kuranjandvar temple route, alt. 1800 m, on tree, SINGH 70.1303 (LWU); Panneikoda, FOREAU 4107 B (AWAS); Shembaganur, alt. 1800 m, on tree trunk, FOREAU 4173, 4173 A (AWAS)—det. Hale; S. H. College compound, AWASTHI 4261 (AWAS)—det. Hale.

11. *Parmelia disparalis* Nyl.

Synop. Lich. 1: 381 1860; Zahlbr. *Cat. Lich. Univ.* 6: 238, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 247, 1965.

Parmotrema disparalis (Nyl.) Hale, *Phytologia*, 28: 336, 1974.

Parmelia tephрина Hue, *Nouv. Arch. Mus. Paris.* ser. 4, 1: 183, 1899. Type: Nilgiri hills, Coonoor, 1893, Gray (P)—not seen.

The type of *Parmelia tephрина* Hue is from India, and it has been synonymized by HALE (1965) to *P. disparalis* Nyl., ascertaining its presence in India. However, we have not been able to determine any specimen to conform to the description of this taxon in the collection with us. The following description is thus based on that given by HALE (l.c.) for ready reference.

Thallus corticolous, foliose, loosely adnate to substratum, up to 15 cm in diameter, mineral grey, lobes rotund, 10-14 mm wide, ascending, margin laciniate, laciniae up to 10 mm long; upper surface smooth, distinctly white maculate, reticulately cracked with age; isidia and soredia absent; lower side black, sparsely rhizinate, a broad marginal zone brown to ivory and mottled, Apothecia up to 15 mm in diameter, pedicellate, amphithecium rugose, maculate; disc imperforate; spores colourless, simple, $16-21 \times 8-10 \mu\text{m}$. Thallus K+yellow, medulla K—, C—, KC+reddish, P+brick red; atranorin and protocetraric acid present.

12. *Parmelia erhizinosa* Awasthi sp. nov.

Plate 14, Fig. 2

Thallus corticola, foliaceus, lax adnatus, usque ad 12 cm diametro, lobi magnis, rotundatis, 8-10 (30) mm natis, parum longitudinaliter convolutis, margine ciliatis, ciliis 0.5-1.5mm longis, superne albicans, laevigatus, opacus, emaculatus, inferne niger vel margine castaneus, erhizinosus, cortice superiore $9-13 \mu\text{m}$, strato algarum $18-25 \mu\text{m}$, medulla alba, $77-110 \mu\text{m}$ crassa, strato cortice inferiore $12-15 \mu\text{m}$. Apothecia desunt. Thallus K+flavescens; medulla K—, C+rubra, KC+rubra, P—; atranorinum et acidum lecanoricum continens

Thallus corticolous, foliose, \pm soft to softly coriaceous, loosely attached to substratum by the central part of the thallus 10—12 cm in diameter, mineral grey to glaucous grey,

irregularly lacinate lobate, lobes imbricate and superposed, rotund, entire to crenate, longitudinally irregularly convoluted, usually 8-10 mm wide, some lobes exceptionally up to 30 mm wide and \pm spatulate; margin ciliate; cilia dense, simple to bifurcated, 0.5-1.5 mm long; isidia and soredia absent; upper surface smooth or faintly rough in older parts, dull, emaculate; lower side minutely reticulately wrinkled, black in greater part, marginal 5-10 mm wide zone light brown to brown, smooth to faintly wrinkled; rhizinae completely absent, thallus apparently attaching by projecting hyphae on underside. Thallus 118-158 μ m thick; upper cortex 9-13 μ m thick, algal stratum 18-25 μ m thick, medulla white, 77-110 μ m thick, lower cortex 12-15 μ m thick. Apothecia and pycnidia absent.

Thallus K+yellow; medulla K—, C+red, KC+red, P—; atranorin and lecanoric acid present.

The new species *Parmelia erhiziosa* has no rhizinae, and is apparently attached to substratum at few places by the hyphae. A few lobes become much enlarged spatulate, and the whole thallus is convoluted and is unlike *P. hololoba* to which it exhibits the closest resemblance. The thickness of the thallus and presence of lecanoric acid is also comparable to *P. hololoba*, but the latter has rhizinae. *P. erhiziosa* is probably a better choice for the esorediate counter part of *P. cooperi* as the two have similar dimorphic lobes.

Specimen examined:

Tamil Nadu—Palni hills, Kodaikanal, Bryant Park, alt. 1960 m, on tree trunk, Dec. 16, 1970, K. P. SINGH 70.1050 (HOLOTYPE: LWU).

13. ***Parmelia euneta* Stirt.**

Scott. Nat. 4: 298, 1877—78; *Zahlbr. Cat. Lich. Univ.* 6: 238, 1930; *Hale Contr. U. S. Nat. Herb.* 36: 325, 1965.

Parmotrema eunetum (Stirt.) Hale, *Phytologia*, 28: 336, 1974.

No specimen from India has been collected so far; description based on specimen from Sri Lanka.

Thallus corticolous, foliose, loosely adnate to substratum, 8-10 cm in size, coriaceous, mineral grey to glaucous grey; lobes rotund, 10-15 mm wide, margin crenate to entire, ciliate; cilia 2-4 mm long, black, thick, tapering; upper surface smooth, faintly maculate; isidia and soredia absent; lower side black, sparsely rhizinate in the central part, marginal 5-8 mm wide zone erhizinate, tan to brown, smooth, shining; medulla white. Apothecia absent in the specimen examined.

Thallus K+yellow; medulla K—, C+red, KC+red, P—; atranorin and gyrophoric acid present.

Parmelia euneta exhibits some resemblance to *P. erhiziosa*, but the upper surface is maculate, rhizinae are present and gyrophoric acid is present. The species is apparently distributed in pantropical parts of the world, and is likely to be collected from Southern India.

Extra-Indian specimen examined:

Sri Lanka—(Ceylon), no precise locality. TIWARY (BM).

14. ***Parmelia flaventior* Stirt.**

Scott. Nat. 4: 254, 1877—78; *Lamb, Index Nom. Lich.* 476, 1963; *Hale, Contr. U. S. Nat. Herb.* 36: 227, 1965.

Parmelia himalayensis Nyl. *Flora*, 68: 605, 1885; *Zahlbr. Cat. Lich. Univ.* 6: 138, 1930

Plate 10, Fig. 1

Thallus corticolous, foliose, closely adnate to substratum, 8-10 (15) cm in diameter, yellowish green to grey or darker in the central part and lighter yellow in the peripheral part; lobes crisp, rounded, 5-10 mm wide, ascending, closely imbricate to confluent, margin

crenate-dentate, eciliate; upper surface smooth to rugulose, irregularly minutely white pseudocyphellate in the peripheral part; soralia marginal, linear, often sinuous, or soralia submarginal capitate, sometimes developing on the pseudocyphellae, only marginal soralia present or both types present; lowerside black, sparsely shortly rhizinate, and often adglutinated to the substratum in the greater central part by hyphae, marginal 2-3 mm wide zone erhizinate, brown to dark tan, upturned, smooth and shining; medulla white. Apothecia very rare (seen in one specimen only), up to 7 mm in diameter, sometimes lobed, constricted at base, imperforate, amphithecium marginally sorediate; hymenium 50-60 μm high; asci 8 spored; spores colourless, simple, oval, $13-17 \times 6-8.5 \mu\text{m}$.

Thallus K—; medulla K—, C+red, KC+red, P—; usnic and gyrophoric acid present.

Zahlbruckner (1930) placed the taxon *P. himalayensis* Nyl. in section *Xanthoparmelia*. Hale (1965) did not include the taxon under *Amphigymnia*, nor has it been mentioned under any of the genera proposed by him later (Hale, 1974 a, 1974 b, 1974 c, 1974 d), thereby indicating that the systematic position of the taxon is undecided. Since the thallus is typically *Parmelia*-like, the lobes are broad, a narrow zone on the lowerside along the margin is erhizinate, the species has been considered here under the subgenus *Amphigymnia*. This taxon happens to be the only pseudocyphellate example of *Amphigymnia*, but the possession of pseudocyphellae is not an unknown condition in *Parmelia* as they occur in several species of subg. *Parmelia* (*P. borrieri*, *P. rudecta*, *P. subrudecta*, etc.).

Parmelia flaventior Stirt. is the correct name for *P. himalayensis* Nyl. vide Hale (*in litt.*), and I have followed the same, though I have not examined the type specimens of either. *Parmelia flaventior* closely resembles *P. ulophyllodes* and the two are often found growing together, both of the same colour and both possessing marginal soralia. The latter is distinguished by a smaller thallus and absence of pseudocyphellae. *Parmelia flaventior* is widely distributed in several northern temperate countries, and also occurs chiefly in the temperate parts of western Himalayas of India.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Himachal Pradesh—Chhika, alt. 2850 m, on tree, Höeg 1766, 1772 (AWAS)—det. Hale; Manali, alt. 1800 m, on tree bark, Awasthi *et al.* (LWU); Chhika to Manali, on bark, Höeg 1866 (AWAS)—det. Hale; Parbati river valley, near Manikaran, alt. 1800—2100 m, on tree trunk, Awasthi & Dange 75.053, 75.100 B (LWU); near Kheer Ganga, alt. 3150 m, on fallen tree, Awasthi & Dange 75.329 (LWU)—fertile; near Pulga, on conifer tree trunk, Awasthi & Dange 75.124, 75.131 A, 75.157, 75.300 (LWU); on boulder, Awasthi & Dange 75.188 (LWU). Jammu & Kashmir—Pahalgaoon, on bark, Awasthi *et al.* (LWU); Sonamarg, on bark, alt. 1950 m, Awasthi *et al.* (LWU); Tamil Nadu—Nilgiri hills, on way to Doddabetta, alt. 1800 m, Singh 73.425 (LWU); Ootacamund Bot. Garden, alt. 2100 m, Awasthi 4445 (AWAS)—det. Hale, 1963. Uttar Pradesh—Almora district, Jageshwar, alt. 1800 m, on *Quercus* tree, Awasthi 3506 (AWAS); Kasardevi, alt. 1800 m, on Pine tree, Awasthi 3453 (AWAS)—det. Hale; Kausani, on Pine bark, Awasthi 3173 (AWAS); Dehradun district, Mussoorie, alt. 1800 m, Awasthi 3813 (AWAS)—det. Hale; Bunkateshwar temple, alt. 2000 m, on *Quercus* tree, Joshi 75.250 (LWU); Lal Tibba, alt. 2550 m, on tree, Joshi 75.376 (LWU); Chakrata, Deoban, alt. 2700 m, on tree trunk, Awasthi & Joshi 76.90 (LWU).

Extra-Indian specimen examined:

Pakistan—Thandiani, alt. 2700, Mc Vean 60.2, 60.7 (AWAS).

15. *Parmelia grayana* Hue.

Nouv. Arch. Mus. Paris, ser. 4, 1:184. 1899; Zahlbr. Cat. Lich. Univ. 6: 239, 1930; Hale, Contr. U. S. Nat. Herb. 36:292, 1965.

Parmotrema grayanum (Hue) Hale, *Phytologia*, 28: 336, 1974.

Plate 12, Fig. 6

Thallus generally saxicolous, rarely terricolous, foliose, adnate to loosely attached to substratum, 4-6 cm in diameter, \pm coriaceous, ashy grey to grey brown; lobes short, rotund, 4-8 mm wide, subimbricate to crowded; margins ascending, crenate-dentate and ciliate; cilia dense, thick, 0.5-2 mm long, simple, tapering; upper surface smooth, epruinose or pruinose, often covered with algal growth, emaculate, marginal area shining; lower side faintly to densely wrinkled, sparsely or densely rhizinate in the central part, marginal 3-5 mm wide zone erhizinate, brown to dark brown, shining; soralia marginal in the central part of the thallus, developed on apices of dents, crisp when over mature; medulla white. Apothecia rare, substipitate, up to 5 mm in diameter, perforated at the centre, disc much concave, amphithecium \pm smooth, margins curved inwards making the apothecia look \pm globular; hymenium (35) 55-65 μ m high; asci 8 spored; spores simple, hyaline, ovoid, 13-20 \times 7.5 - 11.5 μ m, thick walled, often with oily globules inside.

Thallus K+yellow; medulla K—, C—, KC—, P—; atranorin and protolichesterinic acid present.

Parmelia grayana closely resembles *P. praesorediosa* in the marginal soralia, chemical reactions and the general saxicolous habit, but is distinguished by the presence of cilia along the margin. The taxon had been described on the material from Nilgiri hills, and is of common occurrence in Nilgiri and Palni hills, and is also known from other parts of Asia and Africa. There is some variations in the size of thalli and growth of the thallus, but is always easily distinguished by the characters given above.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Tamil Nadu—Nilgiri hills; Coonoor, alt. 1680 m, on rocks, AWASTHI & SINGH 70.1352 (LWU); 2 miles towards Mettupalayam from Coonoor, alt. 1500 m, on rocks, SINGH 71.801 (LWU);—fertile; Emerald Beat, opposite Mukurti Lake, and Nilgiri Peak, alt. 2250 m, on rocks, SINGH 71.759 (LWU); Love Dale, SINGH 73.576 (LWU); Ootacamund to Mysore Road, at 14 km from Ootacamund, on rocks, AWASTHI 4545 (AWAS)—det. HALE, 1965; Upper Bhowani Road, from Avalanche, alt. 2250 m, on rocks, SINGH 71.705 (LWU); at Lakribetta Top, alt. 2400 m, on rocks, SINGH 71.729 (LWU); Palni hills; Kodaikanal, alt. 2100 m, on rocks, AWASTHI 4415 (AWAS)—det. HALE; AWASTHI & SINGH 69.2, 69.4 (LWU)—fertile; 69.16 (LWU)—sterile; Pillar Rocks area, alt. 2260 m, on rocks, SINGH 70.750 (LWU); on way to Night Brun, alt. 1800 m, SINGH 70.1285 (LWU)—fertile; Perumalmalai, near Perumal Peak, alt. 2100 m, on rocks, SINGH 70.1101 (LWU); Hill View, below Perumalmalai, AWASTHI & SINGH 70.449 (LWU); near Mannavanur, alt. 1800 m, on rocks, SINGH 73.17 (LWU); on hard soil, SINGH 73.27 (LWU); Shembaganur, to Perumal Coffee plantation, alt. 1650 m, AWASTHI 4348 (AWAS)—det. HALE, 1965.

16. *Parmelia hababiana* Gyel.

Fedde Repert. Sp. Nov. 29: 288, 1931; Hale, *Contr. U. S. Nat. Herb.* 36: 325, 1965.

Parmotrema hababiana (Gyel.) Hale, *Phytologia* 24: 336, 1974.

Plate 13, Fig. 1

Thallus corticolous, foliose, loosely attached to substratum, medium sized, pale grey, mineral grey to pale brown; lobes rotund, 5-15 mm wide, sparsely ciliate along margin, upper surface smooth, emaculate to faintly maculate, soralia marginal to submarginal, soraliolate lobes revolute; lower side brown to brown black in the central region, sparsely minutely rhizinate-papillate; marginal wide zone erhizinate, ivory, light brownish or mottled, smooth and shining; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K—, C—, KC+reddish, P—; atranorin, protolichesterinic acid present, (cryptochlorophaeic acid present or absent *vide* HALE)

Parmelia hababiana closely resembles *P. rampoddensis* especially if the maculations are absent or are very faint and the marginal zone on lower side is brownish. The distinc-

tion between the two taxa is then limited to the presence of cryptochlorophaeic and protolichesterinic acid in *P. hababiana* and alecoronic acid in *P. rampoddensis*. The taxon is widely distributed in the pantropical regions of the world.

Specimens examined:

Kerala—Travancore, comm. 1954, SESHADRI 2615 (AWAS)—det. HALE, 1965. N. W. Himalaya—No precise locality, FALCONER 96 (BM) pr. p. Tamil Nadu—Nilgiri hills, Ootacamund, Bandy Shola, AWASTHI & SINGH 71.292 (LWU); near Doddabetta, alt. 2100 m, on tea plant, SINGH 71.1046 (LWU); Kotagiri to Kodanad route, near Finger Post, alt. 1890 m, on tree, SINGH 71.827 (LWU); Palni hills, Shembaganur, S. H. College, alt. 1800 m, AWASTHI 4263 (AWAS)—det. Hale; Oothu area, alt. 1050 m, on *Jatropha* bark, AWASTHI & SINGH 70.353 (LWU); Kodaikanal, Bryant Park, alt. 1950 m, SINGH 70.1042 (LWU). Uttar Pradesh—Almora district, Almora, alt. 1600 m, on Pine bark, A. M. AWASTHI 413 (AWAS)—det. HALE; Ranikhet to Chaubattia, on *Cedrus* and Pine barks, AWASTHI 3552 (AWAS)—det. Hale; Pithoragarh district, Askote, near village Sunkote alt. 1350 m, on *Alnus nepalensis* bark, AWASTHI 3317 B, 3320 (AWAS)—det. HALE.

Extra-Indian specimen examined:

E. Nepal—Phenikhola valley, alt. 1500 m, on Pine bark, AWASTHI 2193 (AWAS)—det. HALE.

17. ***Parmelia latissima*** Fée

Ess. Crypt. Suppl. 119, pl. 38, fig. 4, 1837; Zahlbr. *Cat. Lich. Univ.* 6:241, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 253, 1965.

Parmotrema latissimum (Fée) Hale, *Phytologia*, 28: 337, 1974.

Plate 14, Fig. 3

Thallus corticolous, foliose, loosely attached to substratum, \pm coriaceous, 10–25 cm in diameter, mineral grey to pale grey; lobes rotund, up to 20 mm wide, margin entire, eciliate; upper surface dull, plane, smooth, emaculate, centrally \pm rugose; isidia and soredia absent; lower side black, sparsely rhizinate, marginal ca. 10 mm wide zone erhizinate, dark tan, and shining; medulla white. Apothecia copious, prominent, up to 16 mm in diameter, substipitate, imperforate; disc brown; amphithecium rugose maculate; asci 8 spored; spores simple, colourless, ovoid, (16) $24\text{--}29 \times (8) 13\text{--}18 \mu\text{m}$; pycnidia black, in submarginal area.

Thallus K+yellow; medulla K+red, C–, P+orange red; atranorin and salacinic acid present.

Parmelia latissima is characteristic in the absence of marginal cilia, presence of copious apothecia and salacinic acid. The species is mainly restricted in tropical America, having been known from a single collection from India. *Parmelia cristifera* considered as its sorediate counter part is also poorly represented in India. The taxon seems to have disappeared from Calcutta and environs where it was collected by WALLICH in the early 19th century. This may apparently be due to the considerable change in the climatic conditions of Calcutta since Wallichian time. It is also possible that since several tropical American trees were introduced in Calcutta Botanic Garden during that period, propagules of *P. latissima* also got introduced with them and thrived at Calcutta for some time but did not spread or maintain for long.

Specimens examined:

West Bengal—Calcutta, WALLICH (BM)—2 sheets, one det. HALE, 1962 and cited in HALE (1965). Sometimes spores were found to be of the dimension of $16\text{--}29 \times 8\text{--}13 \mu\text{m}$.

18. ***Parmelia margaritata*** Hue.

Nouv. Arch. Mus. Paris, ser. 4, 1: 193, 1899; Zahlbr. *Cat. Lich. Univ.* 6: 243, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 296, 1965.

Plate 10, Fig. 5

Thallus corticolous, foliose, loosely attached to substratum, medium sized, rather coriaceous to crisp, grey to pale grey; main lobes rotund, upto 10 mm wide, with several ascending, simple to dichotomously divided, up to 2 mm wide lacinules irregularly developed from the margins in the central part, margin ciliate; cilia 1–2 mm long; upper surface smooth, dull, densely maculate; soralia terminal on the lacinules, rounded or confluent and sinuous, sorediate lobes revolute; lowerside black, sparsely rhizinate in the central part, marginal area dark brown to tan, erhizinate, and shining or whitish mottled especially in the erect lacinules; medulla white. Apothecia absent in the specimen examined.

Thallus K+yellow; medulla K+red, C–, P+orange red; atranorin and salacinic acid present.

Parmelia margaritata shows a close relation to *P. leucosemotheta* Hue in the presence of marginal cilia and soralia and also in the presence of similar chemical substances. The specimen cited below under *P. margaritata* shows affinity to *P. leucosemotheta* in the maculate upper surface and the white mottled condition on the lower side at marginal area in some parts. But the presence of sorediate erect lacinules have been considered by me of greater importance for determining it as *P. margaritata*, as a faint maculate condition is also reported in that species. The faint to dense maculation is apparently an ecological modification as similar conditions occur in other species (cf. *P. reticulata*). Moreover, the thallus tallies well with figure of this species given in HALE (1965). Development of lighter colour in marginal area in erect lacinules or lobes is also observed in *P. reticulata*. The taxon is so far known from United States and it is the first record of the species occurring elsewhere.

Specimen examined:

Karnataka—Dharwar district, Konankeri, alt. 600 m, on *Ixora parvifolia* bark, 1918, SINGWICK (BM).

19. ***Parmelia mellissii*** Dodge

Ann. Missouri Bot. Gard. 46: 134, 1959; Hale, *Contr. U. S. Nat. Herb.* 36: 297, 1965.

Parmotrema mellissii (Dodge) Hale, *Phytologia*, 28: 337, 1974.

Plate 13, Figs. 2 & 3

Thallus corticolous, saxicolous or terricolous, foliose, loosely adnate to substratum, up to 10 cm in diameter, mineral grey to grey, lobes rotund, 4–15 mm wide, margins crenate to dissected, ciliate and isidiate-sorediate, cilia black, 3–4 mm long, simple; upper surface smooth, emaculate, minutely reticulately fissured later in older parts; soralia marginal developed on marginal isidiate growths, or submarginal, sorediate lobes wavy sinuous, soralia linear to confluent, soredia granular; lower side rugose to minutely wrinkled, black, sparsely rhizinate in groups, marginal 1–3 mm wide zone erhizinate, dark brown to brown black, shining, sometimes lighter or mottled whitish brown in a broad zone near the margin; rhizinae simple to rarely bifurcated or with protuberances at the ends; medulla white. Apothecia rare (seen in a single specimen), up to 8 mm in diameter; disc brown, imperforate; amphithecium rugose; hymenium 75–95 μ m high; spores colourless, simple, oval to ovoid, 19–25 \times 9.5–15 μ m, epispore wall 2 μ m thick.

Thallus K+yellow; medulla K–, C–, KC+reddish, P–; atranorin and alectoronic acid present.

Parmelia mellissii is closely related to *P. rampoddensis* in the marginal soralia and presence of alectoronic acid, but while soralia in *P. mellissii* arise on tips of marginal isidiate

growths with granular soredia, those of *P. rampoddensis* are directly on the margin and farinose. The taxon is widely distributed in the pantropical parts of the world.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Tamil Nadu—Nilgiri hills; Avalanche, alt. 2100 m, on tree, SINGH 71.348 (LWU); Coonoor, on tree, AWASTHI & SINGH, 70.1390 (LWU); Naduvattam *Cinchona* plantation, alt. 1500 m, on *Cinchona* bark, SINGH 72: 82, 72.99 (LWU); Palni hills, Kodaikanal, alt. 2150, on tree, FOREAU & AWASTHI 4240 (AWAS)—det. HALE, SINGH 70.610, 70.723 A (LWU); Bear Shola, on tree, AWASTHI & SINGH 70.3 (LWU); Pambampuram, alt. 2250 m, on tree, SINGH 70.562, 70.577 (LWU); Kuranjiandvar temple route, on tree, SINGH 70.1299 (LWU); Mannavanur, over stones, SINGH 73.16 (LWU); Shembaganur, alt. 1800 m, AWASTHI 4259 (AWAS)—det. HALE; Silver Cascade, alt. 1800 m, over stones by road side, AWASTHI & SINGH 70.33 (LWU); Korapur, on ground, SINGH 70.1218 (LWU). West Bengal—Darjeeling district, alt. 1650 m, on tree, AWASTHI 3923 (fertile), 3925 (AWAS).

20. *Parmelia nilgherrensis* Nyl.

Flora, 52: 291. 1869; Zahlbr. *Cat. Lich. Univ.* 6: 246, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 333, 1965. *Parmotrema nilgherrense* (Nyl.) Hale, *Phytologia*, 28: 338, 1974.

Plate 15, Figs. 2 & 3

Thallus corticolous, foliose, loosely attached to substratum, thick coriaceous, 10–15 cm or more in diameter, mineral grey to ashy grey, lobes plane to convoluted, rotund, 10–20 (30) mm wide, margins ascending, imbricate, entire to crenate-dentate, more so in the central region, ciliate; cilia 1–3 mm long, simple to furcated; isidia and soredia absent; upper surface smooth, dull to shining, densely maculate; lower side minutely wrinkled, black, sparsely rhizinate in groups in central part; rhizinae slender or thick, simple; marginal 4–8 mm wide or broader zone erhizinate, tan to dark brown and shining; medulla white. Apothecia large, usually in plenty, up to 20 mm in diameter, stipitate, imperforate or perforate, disc brown, smooth, amphithecium vertically rugulose, densely maculate; hymenium 100–125 μ m high, asci 8 spored; spores colourless, simple, oval to ovoid, 20–30 \times (7) 11–19 μ m, epispore wall 2–2.5 μ m thick; pycnidia submarginal, often producing a protusion on lower side.

Thallus K+yellow; medulla K–, C–, KC+pinkish, P–; atranorin, alectoronic acid and *a*-collatolic acid present.

Parmelia nilgherrensis is characteristic in its large maculate thallus, marginal cilia and medulla KC+pink reaction. In the thick coriaceous thallus and perforate apothecia and large thick walled spores as well as KC+reaction in medulla it shows resemblance to *Cetraria thomsonii* (Stirt.) Müll. Arg., and the two have often been found growing together in the Himalayan region, but the latter (*C. thomsonii*) is easily distinguished by the marginal well developed pyriform pycnidia, usually developed on dichotomously divided tapering lacinules, while the pycnidia in *Parmelia nilgherrensis* are submarginal. The taxon is widely distributed in Africa and Asia and is one of the common species of *Parmelias* occurring in India.

Specimens examined:

Delhi (?) SMITH (BM)—the locality seems erroneous. Himachal Pradesh—Dharamshala, Mc Leadganj, on *Cedrus deodara* trunk, 1965, SHARMA (AWAS); Kotgarh, Salla, RAGHUBIR, 461 (AWAS); Simla, alt. 2400 m, WATT (BM); Jakhu top, alt. 2400 m, on *Quercus*, AWASTHI 1420 (AWAS). Meghalaya—Khasia hills, Nonkrum, alt. 1500 m, HOOKER & THOMSON 1987 (BM)—same number in another sheet is *Parmelia reticulata*, same locality HOOKER & THOMSON 1837 (BM)—pr. p.+*Cetraria thomsonii* (Stirt.) Müll. Arg.; Shillong, alt. 1800 m, on trees, AWASTHI 6435, 7863, 7868 (AWAS). Sikkim—Jongri, alt. 3900 m, BOSE 6324 (AWAS). Tamil Nadu—Nilgiri hills; Avalanche, alt. 2100 m, on tree, SINGH 71.638, 71.642, 71.317 (LWU); on way to Doddabetta peak, alt. 2400 m, on tree, AWASTHI & SINGH 71.168, 71.115 (LWU); SINGH 71.1072, 71.1083,

73.363, 73.372, 73.385 (LWU); Ootacamund Bot. Garden, alt. 2100 m, on trees, AWASTHI 4448 (AWAS)—det. HALE; Ootacamund to Mysore route, at 16 km, AWASTHI 4524 (AWAS)—det. HALE; Pykara forest range, alt. 2100 m, on trees, AWASTHI & SINGH 71.192, 71.223 (LWU); Upper Bhowani Road, alt. 2250 m, on tree; Singh 71.691 (LWU); Naduvattam Cinchona Plantation, alt. 1500 m, on *Cinchona* tree, SINGH 72.78 (LWU); on way to Nilgiri Peak, SINGH 72.7, 72.35 (LWU), Ootacamund to Kotagiri Road, on tree, SINGH 71.1087, 71.1072, 71.1083, 71.1089 (LWU); Palni hills, Kodaikanal, Golf Club area, alt. 2250 m, on tree, SINGH 70.620 (LWU); Pillar Rocks area, on trees, AWASTHI & SINGH 70.213 (spores $19-24 \times 9-11 \mu\text{m}$), 70.269 (LWU); Kodaikanal to Berijam road, alt. 2250 m, on tree, FOREAU & AWASTHI 4200, 4238 (AWAS). Uttar Pradesh—Almora district, Kasardevi, on Pine, alt. 1800 m, AWASTHI 3441, Kausani, alt. 1800 m, SEN, 3174 (AWAS); Jageshwar alt. 1950 m, on tree, AWASTHI 3504, 3505 (AWAS); Ranikhet—Chaubattia, on tree, AWASTHI 2551 (AWAS); Loharkhet to Dhakuri, on *Quercus* and *Rhododendron* trees, AWASTHI 7562, 7594 (AWAS); Dwali to Phurkia, alt. 3000 m, AWASTHI 7636 (AWAS); Dhakuri, alt. 2700 m, on tree, AWASTHI & AWASTHI 635 A (AWAS) Dehradun district, Mussoorie, alt. ca. 1800 m, HÖEG 1442, 3406 (AWAS)—det. HALE, AWASTHI 3804, 3805, 3806, 3812 (AWAS); Mittal 2611 (AWAS); JOSHI 75.007, 75.103, 75.133, 75.165, 75.229, 75.253, 75.329, 75.378 (LWU); Deoban, alt. 2250 m, AWASTHI & JOSHI 76.65, 76.24, 76.188, 76.102 (LWU); Pithoragarh district, Askote, alt. 1650 m, AWASTHI 3976 (AWAS); Chandak, 1975 AWASTHI (AWAS); Uttarkashi district, Silkara to Gangrani, on tree, AWASTHI 889 (AWAS); Chinar, alt. 2610 m, STRACHEY & WINTERBOTTOM (BM)—pr. p. + *Parmelia reticulata*; N. W. Himalaya—No precise loc. FALCONER 96 A (BM) pr. p. West Bengal—Darjeeling district, Tiger hill, Sanchal, alt. 2100 m, AWASTHI (AWAS); BOSE 63.85 (AWAS); near Sandakhpoo, alt. 3300 m, AWASTHI & AGARWAL 67.359 (LWU).

Extra-Indian specimens examined:

Nepal—E. Nepal, Rakshe to Ethung, alt. 2100 m, on *Quercus*, AWASTHI 2111 (AWAS); Ascent to Sandakhpoo from Nepal side, alt. 2850 m, AWASTHI 2467 A (AWAS); Cho-Oyu, near Mahabir temple, alt. 2500 m, ROLLA RAO 13637 (AWAS, SHILLONG). Pakistan—Thandiani alt. 2700 m, on tree, Mc VEAN 60.38 (AWAS).

21. ***Parmelia permutata* Stirt.**

Scot. Nat. 4: 252.1877—78; *Zahlbr. Cat. Lich. Univ.* 6: 261, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 302, 1965. *Parmotrema permutatum* (Stirt.) Hale, *Phytologia*, 28:338, 1974.

Plate 12, Fig. 1

Thallus corticolous, foliose, loosely attached to substratum, small, 4 cm in diameter, mineral grey; lobes rotund, up to 10 mm wide, entire to crenate, margin densely ciliate, cilia 3-4 mm long, simple to bifurcated; upper surface smooth, emaculate; soralia marginal, on apices of dents in lateral margin of central part, linear; lowerside black, sparsely rhizinate in central part, marginal 2-4 mm wide zone erhizinate, dark brown, shining; medulla white in upper part and yellow in lower part, pigmented zone K—. Apothecia absent in specimen examined.

Thallus K+yellow; medulla K—, C+reddish, KC+reddish, P—; atranorin and gyrophoric acid present, [an identified pigment also reported by HALE (1965) and WINNEM (1975)].

Parmelia permutata is known from few localities in Australia, Africa and Asia. It is distinguished by the small thallus and the medulla yellow in lower part. It is liable to be confused with *P. sancti-angelii* if medulla is not examined carefully.

Specimen examined:

West Bengal—Darjeeling, THOMSON (BM)—det. HALE, 1965.

22. ***Parmelia praesorediosa* Nyl.**

Sert. Lich. Trop. Labuan Singapore, 18, 1891; *Zahlbr. Cat. Lich. Univ.* 6:262, 1930; Hale, *Contr. U. S. Nat. Herb.* 36:258, 1965.

Parmotrema praesorediosum (Nyl.) Hale, *Phytologia*, 28:338, 1974.

Plate 12, Fig. 3

Thallus saxicolous or corticolous, foliose, \pm suborbicular, adnate to the substratum, 3-8 cm in diameter, mineral grey, yellowish grey to darker grey; lobes subrotund to rotund, 5-8 mm wide; margins ascending, \pm imbricate, sinuous, eciliate; upper surface smooth, emaculate, minutely reticulately cracked in older parts; soralia marginal to rarely submarginal, crescent shaped or sinuous but discontinuous; soredia granular; lowerside black, adnate to substratum, minutely wrinkled, sparsely rhizinate in central part, marginal 2-4 mm wide zone erhizinate, lighter tan, smooth and shining; rhizinae 1-2 mm long, blackish, simple; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K—, C—, KC—, P—; atranorin and caperatic acid present.

Parmelia praesorediosa is rather characteristic in the non-ciliate, but sorediate margins and negative colour reactions in medulla by K, C, KC, and P. The species is widely distributed in pantropical regions of the world, and is also frequent in similar situations in India.

Specimens examined:

Madhya Pradesh—Hoshangabad district, Pachmarhi, alt. 1050 m, on rocks, SINGH 73.155, 73.183, 73.202, 73.203 (AWAS). Maharashtra—Shimoga, on rocks, AWASTHI 3594 (AWAS). Tamil Nadu—Palni hills, Kodai-kanal road on way to Gumpurai, alt. 1050 m, SINGH 70.1270 (LWU); Oothu area, alt. 1050 m, over rocks, AWASTHI & SINGH 70.356 (LWU); on stony fence wall of orchard, AWASTHI & SINGH 70.400, 70.401 (LWU). Uttar Pradesh—Almora district, Kapkote to Loharkhet, alt. 1200 m, on rocks, AWASTHI 7520 (AWAS); Nainital district, Kali river valley, near Tanakpur on way to Poornagiri, alt. 450 m, on *Shorea robusta* bark, AWASTHI 3177, 3178 (det. HALE), 3370 (AWAS); Pithoragarh district, Askote, Gori river valley, alt. 900 m, on rock, AWASTHI 3321 (AWAS)—det. HALE, 1965; near village Naret, alt. 1290 m, on bark, AWASTHI 3291 B (AWAS), on rocks, AWASTHI 3289, 6419 (AWAS). West Bengal, Jalpaiguri district, Manabari tea estate, alt. 300 m, on *Albizia* tree trunk, AWASTHI & AGRAWAL 66.48 (LWU).

Extra-Indian specimen examined:

Nepal—Biratnagar, alt. 300 m, on tree trunk, AWASTHI & CHILKOTI 513 (AWAS)—det. HALE, 1965.

23. *Parmelia pseudonilgherrensis* Asah.

J. Jap. Bot. 29: 370, 1954; Lamb *Index Nom. Lich.* 495. 1963; Hale, *Contr. U. S. Nat. Herb.* 36: 337, 1965.

Plate 12, Fig. 4

Thallus generally corticolous, rarely terricolous, foliose, loosely attached to substratum, \pm coriaceous, medium sized, 5-8 cm in diameter, ashy grey to dark grey, especially in central part; lobes rotund, 10-15 mm wide, margins \pm ascending, imbricate, sinuous, ciliate; cilia 2-3 mm long, simple, rarely forked, margins in the central region \pm dentate; upper surface smooth, densely white maculate; soralia on apices of dentations in central part of thallus, becoming confluent and linear, and sinuous; sorediate lobes involuted, soredia granular, older soralia turning brown black; lowerside smooth to minutely wrinkled, black, shining, sparsely rhizinate in groups in central part, marginal 2-4 mm wide zone erhizinate, dark tan to dark brown, shining; medulla white. Apothecia very rare (seen in a single specimen), sessile, 2.5 mm in diameter; disc concave cup shaped, brown; amphithecium rough maculated; hymenium 45-60 μ m high, I—; epithecium pale brown; hypothecium hyaline, 30-55 μ m thick; asci not well developed; paraphyses simple.

Thallus K+yellow; medulla K—, C—, KC+reddish, P—; atranorin and a-collatolic acids present.

Parmelia pseudonilgherrensis is densely maculate like *P. nilgherrensis*, but differs in somewhat thinner, less coriaceous thallus with sorediate margins. It is known from Africa and eastern Asia and is fairly well represented in India.

Specimens examined:

Himachal Pradesh—Kulu alt. 2000 m Awasthi *et al.* (LWU); near Chhikka in Spiti valley, alt. 2850 m, on tree HÖEG 1770 (AWAS); Parbati river valley, Pulga—Bhandagthaj, alt. 2400 m, on tree, AWASTHI & DANGE 75.284, 75.291 (LWU). Maharashtra—Panchgani, on tree, AWASTHI 4060 4065 (AWAS)—det. Hale. Sikkim—Ghongtam, alt. 2000 m, HOOKER 2002 (BM)—pr. p. + *P. tinctorum*; Wallamchoor alt. 3900 m, HOOKER 1814 (BM)—pr. p. Tamil Nadu—Nilgiri hills, Ootacamund—Kotagiri road, alt. 2250 m, on ground, SINGH 71.1103 (LWU); Pykara, alt. 2100 m, on tree, SINGH 71.1129 (LWU); Upper Bhowani road, near Lakribetta alt. 2400 m, on tree, SINGH 71.746 (LWU); Palni hills, at 14 km on Kodaikanal to Brijam road, on tree, FOREAU & AWASTHI 4242 (AWAS)—det. HALE. Uttar Pradesh—Uttarkashi district, above Jamnotri, alt. 3500 m, on *Quercus* tree, AWASTHI 905 (AWAS)—apothecia present, spores not developed, det. Hale, 1965.

24. ***Parmelia rampoddensis*** Nyl.

Acta Soc. Sci. Fenn. 26 (10): 7, 1900; Zahlbr. *Cat. Lich. Univ.* 6: 263, 1930; HALE, *Contr. U. S. Nat. Herb.* 36: 304, 1965.

Parmotrema rampoddense (Nyl.) Hale, *Phytologia*, 28: 338, 1974.

Plate 14, Fig. 1

Thallus corticolous, foliose, loosely attached to substratum, large, 10-15 cm in diameter, glaucous grey to grey, lobes rotund, 10-20 mm wide, margins subascending, imbricate, sinuous, and ciliate; cilia simple or once or twice furcated, rather robust, 2-3 mm long, sparse to close; upper surface smooth, emaculate, cracked in older parts; soralia marginal in the central part of the thallus, linear, subcontinuous to continuous; sorediate lobes revolute, soredia farinose; lower-side prominently wrinkled, black, sparsely rhizinate; rhizinae thick, simple to branched, marginal 2-3 mm wide zone erhizinate, dark tan and shining; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K—, C—, KC+pinkish red, P—; soralia P—; atranorin and alectoronic acid present.

Parmelia rampoddensis closely resembles *P. hababiana* but is distinguished by emaculate upper surface and presence of alectoronic acid. The type of taxon is a specimen from Ceylon (=Sri Lanka) (holotype at H). It is distributed in pantropical regions of the world. It closely resembles *P. direagens*, but differs in less coriaceousness of thallus and P—reaction in the soralia.

Specimens examined:

Madhya Pradesh—Hoshangabad district, Pachmarhi, alt. 1050 m, on tree trunk, S. SINGH 73.172 (AWAS). Tamil Nadu—Nilgiri hills, Kotagiri to Kodanad route, near Finger Post, alt. 1890 m, on tree, SINGH 71.937 (LWU); Gudalur, near Naduvattam, on *Cinchona* bark, SINGH 73.566 (LWU). Uttar Pradesh—Almora district, Kasardevi, alt. 1800 m, AWASTHI 3448 B (AWAS).

Extra-Indian specimen examined:

Sri Lanka—(Ceylon), Ramboda, ALMQUIST (H—Hb Nyl. 3555—Holotype).

25. ***Parmelia reticulata*** Tayl.

In Mack., *Fl. Hibern.* 2: 148, 1836; Zahlbr. *Cat. Lich. Univ.* 6: 192, 1930.

Parmelia clavulifera Räs. *Ann. Bot. Soc. Zool. Bot. Fenn.* 'Vanamo', 20(3): 4, 1944. Type: Oceania, Tahiti, on bark, 1868, E. VIEILLARD (Holotype: H; Isotype: BM).

Plate 12, Fig. 2

Thallus corticolous, saxicolous or rarely terricolous, foliose, loosely to closely attached or sometimes almost adnate to substratum, 6-20 cm in diameter, mineral grey to grey or darker grey, lacinate lobate; lobes rotund to subrotund, discrete to imbricate, (3) 5-10(15) mm wide, laterally in central part of thallus often with shortly dentate to dichotomous

tomously divided \pm elongated lobes or finger like lacinules; margins ascending, ciliate; cilia 1-2 (2.5) mm long, sparse to dense; upper surface dull, smooth, with distinct to subdistinct reticulate maculae, often reticulately fissured or cracked in older parts, rarely surface \pm shining when maculae are subdistinct in the marginal area; thallus sorediate; soralia developing on narrow to rounded involute lobes in submarginal area, and soon becoming almost marginal, or soralia \pm capitate at the apices of the narrow or finger-like lacinules, the soralia in the former condition often become confluent while in the latter case they remain free, but both types are sometimes present in the same thallus; lowerside black, usually densely rhizinate up to the margin, sometimes the sorediate elongated lacinules pale brown to yellow brown in the marginal region and the rhizinae are sparse to absent; rhizinae simple to squarrosely branched, sometimes rhizinae and rhizinal papillae interspersed; medulla white or rarely croceus due to decomposition of salacinic acid. Apothecia rare, laminal, shortly stipitate, up to 5 mm in diameter; disc dark brown, perforate or imperforate; amphithecium smooth, rarely marginally sorediate; stalk longitudinally lacunose; hymenium 60-75 μ m high; asci 8 spored; spores colourless, simple ovoid, 13-19 \times 6-10 μ m; paraphyses simple, septate.

Thallus K+yellow; medulla K+yellow turning deep red, C—, P+orange red; atranorin and salacinic acid present.

Parmelia reticulata is easily distinguished by the minute reticulate maculations on the upper surface, the marginal to submarginal soralia and the presence of salacinic acid. In the type material (H, BM) of *P. clavulifera* Räs., there are finger shaped lacinules developed from the lobes in the central part of the thallus, these lacinules have capitate soralia, and the lowerside of these is erhizinate, pale brown to yellow brown for 3-5 mm wide zone. RÄSÄNEN (l. c.) stated the medulla to be P—, but it is P+orange red. Thus except for the elongated sorediate lacinules the taxon is identical to *P. reticulata* in reticulate maculae, the chemical reactions and the presence of cilia and rhizinae. After examining the large number of specimens it has been observed that there are all stages of intermediate conditions of the development of the elongated lacinules from the short dentate margins, and often the same thallus shows variations. The colour of the lower side at these sorediate lacinules is also not uniform, it varies from black to spotted or pale brown. It is likely that since these lacinules have a tendency to be suberect to erect the rhizinae are not developed and the colour also becomes lighter. Consequently *P. clavulifera* Räs. is not being considered as an autonomous species. In the closely related *Parmelia cetrata* also there is a similar development of dichotomously divided lacinules in the central part of the thallus, which however are esorediate. HALE (1974 a) transferred *Parmelia cetrata* to *Parmotrema cetrata*, though for reasons not given left out *Parmelia reticulata*.

Parmelia reticulata is widely distributed throughout the pantropical parts of the world, and is also widely represented in India. It had been considered to be a member of subgenus *Parmelia* by HALE and KUROKAWA (1964), but is better placed in subgenus *Amphigymnia*, with rotund lobes, marginal long cilia corresponding to those of other *Amphigymnias*.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Assam—Kynshi I. B., on *Pieris* stem, PANIGRAPHI 16322 (AWAS, SHILLONG). Himachal Pradesh—Manali, alt. 1800 m, HÖEG 1504 (AWAS); AWASTHI *et al.* (LWU) AWASTHI & DANGE 75.027 (LWU); Nankaran, AWASTHI & DANGE 75.114 (LWU); Parbati river valley, near Pulga, alt. 2220m, on coniferous tree, AWASTHI & DANGE 75.121, 75.126 A, 75.149 (fertile) (LWU); Simla, on *Cedrus deodara* tree trunk, AWASTHI 1421 (AWAS). Meghalaya—Khasia, Kellong alt. 1500 m, HOOKER & THOMSON 1987 (BM)—same number in an-

other sheet (BM) is *Parmelia nilgherrensis* Nyl.; Shillong, on rocks, PANIGRAHI 3822 (AWAS); Mophlong forest, alt. 1800 m, on tree, AWASTHI 7854 (AWAS); Upper Shillong Peak, alt. 2100 m, on tree, AWASTHI 7870 (AWAS); Shillong—Jowai route, on trees of Pine, AWASTHI 8006, 8012, 8025 (AWAS). Sikkim—No precise loc. THOMSON 282 (BM); on tree trunk, AWASTHI 32 (AWAS). Tamil Nadu—Nilgiri hills, Coonoor, on hard soil by road side, AWASTHI & SINGH 70.1314 (LWU); Avalanche, on tree trunk, SINGH, 71.352, 71.641 (LWU), Gudalur, on Chinchona bark, SINGH 73.564, 73.605 (LWU); Emerald road, SINGH 73.459, 73.489 (LWU); Kodanad, on bark of tree, AWASTHI & SINGH 70.1507 (LWU); Konada to Kilkotagiri, alt. 1800 m, AWASTHI & SINGH 71.55 (LWU); Love Dale, on tree trunk, SINGH 73.528 (LWU); Naduvattam, on Cinchona trees, SINGH 72.81 (LWU); Mettupalayam road from Coonoor, on bark, SINGH 71.897 (LWU); Ootacamund, AWASTHI 4527 (AWAS); on tea plant, SINGH 71.1042 (LWU); Doddabetta Peak, alt. 2400 m, on rocks and tree trunk, SINGH 71.110, 72.117, 73.390, 73.391 (LWU); Kotagiri to Kodanad, on bark, SINGH 71.918 A (LWU); Palni hills; Kodaikanal area, alt. ca. 2100 m, HÖEG 2518 (AWAS); AWASTHI & SINGH 69.1, 70.2, 73.1, (LWU); Kodaikanal to Berijam, at 15 km, on tree, FOREAU & AWASTHI 4236 (AWAS)—det. HALE; near Berijam Lake, FOREAU 4103 (AWAS)—det. HALE; Shembaganur on trees, FOREAU & AWASTHI 4304 (AWAS)—fertile, det. HALE; S. H. College, on tree, FOREAU 4177, AWASTHI 4260 (AWAS)—det. HALE; near Silver Cascade, on rocks, AWASTHI & SINGH 70.42 (LWU); Pillar Rocks area, on trees and shrubs, AWASTHI & SINGH 70.22, 70.199, SINGH 70.746 70.751 (LWU); Pambampuram, on tree, alt. 2250 m, SINGH 70.559 (LWU); Pencikodu, FOREAU 4119 (AWAS); Sirudamkanal Shola, FOREAU 4562 (AWAS)—det. HALE; Oothu area, on stones and rocks, and bark of tree AWASTHI & SINGH, 70.371, 70.381 (LWU); near Mann-Vanur, SINGH 73.20 (LWU); on way to Kuranjiandvar temple, alt. 1800 m, SINGH 70.1300 (LWU). Uttar Pradesh—Almora district; Almora Takula road, on ground, AWASTHI & AWASTHI 556 (AWAS); Almora alt. 1600 m, AWASTHI 3524 (AWAS); Kasardevi, alt. 1800 m, on Pine tree trunk, AWASTHI 3440 (AWAS); Kausani, on tree, SEN 3170 (AWAS); Loharkhet to Dhakuri, AWASTHI 7541, 7575 (AWAS); Ranikhet to Chaubattia, on tree, AWASTHI 3544 (AWAS); Pithoragarh district, Askote, Dhanlek, on trees, AWASTHI 2681, 2708, 3968 (AWAS); Digtarh, on tree, AWASTHI 3925 (AWAS); Dehradun district, Mussoorie, on trees, AWASTHI 3807, 3808 (AWAS); Uttarkashi district, Purola, alt. 2100 m, on tree, AWASTHI 976 (AWAS). West Bengal—Daijeeling district, near Kurseong, on tree trunk, AWASTHI 3918 (AWAS)—fertile, det. HALE; AWASTHI & AGARWAL, 66.146, 66.152, 66.215 (LWU); Tiger hills, on trees, AWASTHI & AGARWAL 67.23, 67.140 (LWU); Observatory hill, over stones, AWASTHI 3868 (AWAS)—det. HALE; Pashok road, AWASTHI & AGARWAL 67.165 (LWU); Kalimpong division on tree, AWASTHI & AGARWAL 67.328 A, 67.234 B, 67.283 (LWU); BOSE 60.57 (AWAS).

Extra-Indian specimens examined:

Nepal—E. Nepal, near Ethung, above Phidim, alt. 2400 m, on twigs, AWASTHI 2138 (AWAS); above Phidim, over stones AWASTHI 2158 (AWAS)—fertile, apothecia perforated; Near Nigala village, alt. 2100 m, on *Berberis*, ROLLA RAO 13557 (AWAS).

26. ***Parmelia saccatiloba* Tayl.**

Lond. J. Bot. 6: 174, 1847; *Zahlbr. Cat. Lich. Univ.* 6: 264, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 262, 1965.

Parmotrema saccatilobum (Tayl.) Hale, *Phytologia*, 28: 339, 1974.

Plate 9, Fig. 3

Thallus corticolous, foliose, closely adnate to substratum, up to 10 cm in diameter, mineral grey to grey; lobes rotund, 4-10 mm wide, convolute tubular in the peripheral region; margins entire, eciliate; upper surface smooth, dull, emaculate, isidiate; isidia laminal, simple, granular to filiform, rarely branched; lowerside black, sparsely rhizinate in central part, marginal area erhizinate, brown and shining; medulla white. Thallus sterile.

Thallus K+yellow; medulla K—, C—, KC+ reddish, P+ red; atranorin and protocetraric acid present.

The thallus of *Parmelia saccatiloba* is externally very similar to the thallus of *P. tinctorum* in colour and presence of isidia and eciliate margins. *P. saccatiloba* is distinguished by ± convoluted lobes, somewhat smaller sized isidia and the medulla C—reaction. The taxon reported to be restricted in South Pacific region is reported from India for the first time. The specimens had been collected from Calcutta more than a century back, and like *P. cristifera*, and *P. latissima* has not been collected again from the area.

Specimens examined:

West Bengal—Indian (Royal) Botanic Garden, 1866-67, KURZ (BM)—two specimen sheets each with well developed thallus, which is densely isidiate; Sibpur, KURZ (BM)—small piece belonging to Herb. Leighton.

27. ***Parmelia sancti-angelii*** Lynge

Ark. f. Bot. 13(13): 35, 1914; *Zahlbr. Cat. Lich. Univ.* 6: 265, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 306, 1965.

Parmotrema sancti-angelii (Lynge) Hale, *Phytologia*, 28: 339, 1974.

Parmelia pseudohyporysaea Asahina in Kihara, *Faun. Fl. Nepal Himalaya*, 54, fig. 19, 1955.

Plate 12, Fig. 5

Thallus generally corticolous, rarely saxicolous, foliose, loosely attached to substratum, coriaceous, large, 10-15 cm in diameter, glaucous white, grey to darker grey; lobes rotund, upto 15 mm wide; margins ascending, \pm imbricate, entire to crenate, ciliate; cilia dense or rarely sparse, simple to once or twice bifurcate, 2-3 mm long, tapering; upper surface plane, emaculate, smooth, dull to shining, rough reticulately cracked in older parts; soralia marginal to rarely submarginal, linear, discontinuous to continuous, sinuous; sorediate lobes involute, younger soralia farinose, older brown blackish; lowerside black, minutely wrinkled, sparsely rhizinate in the entral part; marginal 5-8 mm wide zone erhizinate, dark tan to brown black, shining; rhizinae thick, in groups in central part of thallus; medulla white. Apothecia absent in specimens examined.

Thallus K+yellow; medulla K—, C+ red, KC+red, P—; atranorin and gyrophoric acid present.

Parmelia sancti-angelii is distinctive in its large coriaceous, emaculate thallus, ciliate and sorediate margins, and medulla C+ red, KC+ red reactions. In marginal sorediate and ciliate conditions and the chemical reaction in medulla it shows similarity to *P. permutata*, which however has a small sized thallus, and the medulla is yellowish, K—, in lower part. A coloured medulla in lower part has been reported in some cases by HALE (1965), but then the pigmented part is K+ purple. None of the specimens examined had a pigmented medulla in *P. sancti-angelii* specimens. The taxon is widely distributed in pantropical regions of the world and also widely distributed in India. Variations in the nature and density of cilia and the habit of soralia and their colour is frequent.

Specimens examined:

Meghalaya—Shillong to Jowai route, at 25 km from Shillong, on bark of Pine tree, AWASTHI 8010 (AWAS)
Tamil Nadu—Nilgiri hills, Coonoor, alt. 1680 m, on tree trunk, AWASTHI & SINGH 70.1328, 70.1351 (LWU); Kodanad tea estate, alt. 1900 m, on tree, AWASTHI & SINGH 70.1409, 70.1511 (LWU); Palni hills; Kodaikanal, alt. 2100 m, on tree bark, AWASTHI & SINGH 69.22 (LWU); Höeg 2520 (AWAS); Pillar Rocks, alt. 2250 m, on tree, AWASTHI & SINGH 70.273, 70.293 (LWU), SINGH 70.733 (LWU); Bryant Park, on bark, SINGH 70.1039 (LWU), on way to Gumparai, on tree, SINGH 70.1258 (LWU); Oothu area, alt. 1200 m, on bark AWASTHI & SINGH 70.366, 70.402, on rocks, 70.367 (LWU)—rhizinae dense in saxicolous specimen; Shembaganur, Tiger Shola, alt. 1650 m, on rocks, AWASTHI & SINGH 70.132 (LWU)—a narrow naked zone along lower side margin, rhizinae dense; Sirudumkanal shola, alt. 1875 m, on tree, FOREAU 4550 (AWAS)—det. HALE, 1965. Uttar Pradesh—Almora district, near Kasardevi, alt. 1800m, AWASTHI 3448 (AWAS); Loharkhet to Dhakuri, alt. 2250 m, on tree, AWASTHI 7557 (AWAS); Berinag, near forest rest house, on *Aesculus indica* bark, AWASTHI 807 (AWAS); Ranikhet to Chaubattia, alt. 1650 m, on rocks, AWASTHI 3527, 3546 (AWAS); Dehradun district, Mussoorie, alt. 2100 m, on rocks AWASTHI 3810, 3811 (AWAS)—det. HALE, 1965; Mussoorie, on tree, JOSHI 75.040, 75.131, 75.141, 75.279 (LWU); Nainital district, near Tanakpur, on way to Poornagiri, alt. 300 m, on bark, AWASTHI 3176, 3368 (AWAS)—det. HALE, 1965; Pithoragarh district, Askote, Dhanlek, alt. 1850 m, on twigs, AWASTHI 2706 (AWAS); Lucknow (?)—the locality seems erroneous, 1917, leg ?, No. 36961 of Herb. Eco. Bot. Bot. Sur. India (BM)—pr. p.+*P. nilgherrensis*. West Bengal—Darjeeling district, Darjeeling Bot. Garden, alt. 1950 m, AWASTHI 3836 ((AWAS)—det. Hale, 1965; Kurseong, alt. 1800 m, AWASTHI & AGARWAL

66.216 (LWU); Choonabhatti to Tindharia, AWASTHI & AGARWAL 66.130 (LWU); Kalimpong, Bose 60.50, 60.190 (AWAS); Kalimpong to Munsong road, AWASTHI & AGARWAL 67.276, 67.284 (LWU).

Extra-Indian Specimen examined:

Nepal—No precise locality, 1952, BANERJEE 1418 (AWAS).

28. ***Parmelia stuppea*** Tayl.

Lond. J. Bot. 6: 174, 1847; *Zahlbr. Cat. Lich. Univ.* 6: 235, 1930 as s. n. to *P. corrugis*; Hale, *Cont.*; *U. S. Nat. Herb* 36: 308, 1965.

Parmotrema stuoppeum (Tayl.) Hale, *Phytologia*, 28: 339, 1974.

Plate 11, Fig. 4

Thallus corticolous, rarely saxicolous, foliose, loosely attached to substratum, rather large, 10-15 cm in diameter, mineral grey to grey; lobes 10-20 mm wide, rotund, marginally subascending; margins irregularly crenate-dentate, ciliate; cilia sparse to dense, simple, 1-3 mm long; upper surface dull, smooth, emaculate, reticulately cracked in older parts; soralia marginal or submarginal on apices of dents in central part, often becoming confluent appearing minutely wavy; sorediate lobes involute; soredia farinose; lowerside smooth to minutely wrinkled, black, uniformly or sparsely rhizinate in the central part with papillae near the margins, marginal 4-6 mm wide zone erhizinate, dark brown to tan, \pm shining; medulla white. Apothecia absent in the specimens examined.

Thallus K+ yellow; medulla K+ yellow turning red, C—, P+ deep yellow to orange; atranorin and salacinic acid present.

Parmelia stuppea shows some resemblance to *P. cristifera* and *P. rampoddensis* in the large lobes and marginal soralia, but *P. cristifera* is eciliate though chemical reactions are similar, and *P. rampoddensis* though ciliate, the soralia are linear, sorediate lobes revolute and the medulla is K—. *Parmelia stuppea* is mostly distributed in African and American tropics, and is known in India from the S. Indian hills only.

Specimens examined:

Tamil Nadu—Nilgiri hills, Coonoor⁴ alt. 1680 m, on tree, SINGH 70, 1351 A (LWU) Emerald Beat (opp. Makurti Lake, and Nilgiri Peak, alt. 3250 m, over rocks, SINGH 74.754, 71.760 (LWU)—the thallus is \pm coriaceous, the soralia are confluent, the medulla is coriaceous to reddish, apparently due to decomposition of salacinic and on the saxicolous habitat; Kodanad area, alt. 1800 m, on tree trunk, AWASTHI & SINGH 70, 1506, 71.677 (LWU); Finger Point, on tree, SINGH 71.918 (LWU)—pr. p. + *P. reticulata*; Mettupalayam road, near Hill Grove, on tree, SINGH 71-844 (LWU); Palni hills; Perumal Coffee Plantation, alt. 1600 m, on tree AWASTHI 4345 (AWAS)—det. HALE, 1963; Manavanur, on tree, SINGH, 73.11 (LWU); Shembaganur, 1800 m, on *Artocarpus* tree, FOREAU 4173 B (AWAS).

29. ***Parmelia subarnoldii*** des Abb.

Man. Inst. Sci. Madagascar ser. B, 10:113, 1961; Hale, *Contr. U. S. Nat. Herb.* 36: 309, 1963.

Parmotrema subarnoldii (des Abb.) Hale, *Phytologia*, 28: 339, 1974.

Plate 11, Fig. 2

Thallus corticolous, foliose, \pm adnate to substratum, sometimes scrobiculate in the central region, 5-6 cm in diameter, glaucous white to mineral grey; lobes rotund, up to 20 mm wide, marginally ascending imbricate, and with crenate lobules; margin (sometimes lamina) ciliate; cilia dense, 3-5 mm long, simple to bifurcated; upper surface plane, smooth, emaculate soralia initially on apices of dents and discontinuous, later confluent, continuous and sinuous; soredia farinose; lowerside smooth to minutely wrinkled, shining, sparsely rhizinate in central region, marginal 4-6 mm wide zone light to dark tan, erhizinate, shining; rhizinae minute tubercle-like or thickened; medulla white. Apothecia absent in specimens examined.

Thallus K+ yellow; medulla K—, C—, KC+ red, P+ orange red to bright red; atranorin and protocetraric acid present.

Parmelia subarnoldii shows resemblance to small thalli of *P. sancti-angelii*, which however is coriaceous, the medulla C+ red, P—. *Parmelia subarnoldii* is distributed in the pantropical parts of the world, but had not so far been reported from India.

Specimens examined:

Tamil Nadu—Palni hills, Kodaikanal, Pillar Rocks area, alt. 2250 m, on tree trunk, AWASTHI & SINGH 70 268 (LWU) in 70.279 (LWU) infected by fungus, with black rounded spots; at 14 km shola on Kodaikanal—Berijam road, alt. 2250 m, on tree twigs, FOREAU & AWASTHI 4241 (AWAS)—the specimen had been determined as *P. rampoddensis* by HALE in 1965, but the medulla is distinctly P+orange red, and hence it is *P. subarnoldii*.

30. ***Parmelia subsumpta* Nyl.**

Flora, 52: 117, 1869; *Zahlbr. Cat. Lich. Univ.* 6: 367, 1930; *Hale, Contr. U. S. Nat. Herb.* 36: 315, 1965.

Plate 11, Fig. 1

Thallus corticolous, foliose, loosely attached to substratum, coriaceous, large, upto 15 cm in diameter, mineral grey to pale grey or grey; lobes rotund to subrotund, upto 10 mm wide, marginally subascending imbricate, margins crenate, densely ciliate; cilia 1.5 mm long; upper surface plane, dull, white maculate, not shining, reticulately fissured in older parts; soralia marginal in central part, confluent and linear, sorediate lobes involute, soredia farinose or granular; lowerside pale brown to blackish in patches in central part, densely shortly rhizinate, rhizinae or rhizinal papillae up to the margin or rarely a narrow erhizinate zone along the margin; rhizinae dimorphic, some short, thin and simple, others upto 1 mm thick, and squarrosely branched; medulla white. Apothecia very rare (seen in a single specimen), 3-5 mm in diameter, stipitate, imperforate; disc brown, amphithecium sorediate along margin; hymenium 58-65 μ m high; asci 8 spored; spores colourless, simple, ellipsoid, 15-19 \times 6-8 μ m.

Thallus K+ yellow; medulla K+ yellow turning red, C—, P+orange red, atranorin and salacinic acid present.

Parmelia subsumpta is rather distinctive in the presence of rhizinae or rhizinal papillae upto the margin and the dimorphic rhizinae. Two types of rhizinae are also known in *P. yodae*, but the chemical reactions are different (*P. yodae*, medulla is K—, C—, KC+ reddish, P—). The maculate condition, reticulately cracked condition of upper surface and the chemical reactions are sub-similar to *P. reticulata*, but in *P. reticulata* the maculations are reticulate and lower side is black. *P. subsumpta* is widely distributed in tropical America and Africa, and is known from hills in India.

Specimens examined:

Unless stated otherwise the specimens are sterile.

Meghalaya—Shillong, near Mawlai, alt. 1500 m, on *Euphorbia royleana* bark, AWASTHI 7907 (AWAS).
Tamil Nadu—Nilgiri hills, Kodanad, on tree, AWASTHI & SINGH 70.1512 (LWU); on way to Nilgiri peak, alt. 2250 m, SINGH 72.36 (LWU); Palni hills, Kodaikanal, on tree trunks, SINGH 70.634, 70.814 (LWU); Perumal peak, SINGH 70.1085 (LWU)—fertile; Shembaganur, on tree, AWASTHI 4258 (AWAS)—det. HALE, 1965; Pambampuram, SINGH 70.569, 70 602 (LWU).

31. ***Parmelia subtinctoria* Zahlbr.**

Symb. Sin. 3: 193, 1930; *Hale, Contr. U. S. Nat. Herb.* 36: 317, 1965.

Parmotrema subtinctorium (Zahlbr.) Hale, *Phytologia*, 28: 339, 1974.

Plate 9, Fig. 4

Thallus corticolous, foliose, saxicolous or terricolous, loosely adherent to substratum, usually medium sized, 4-6 (10) cm in diameter, often scrobiculate in the central part, pale grey, grey to darker grey; lobes rotund, 10-20 mm wide, marginally crenate-dentate and ciliate at dents; cilia 1-2 (3) mm long; upper surface smooth, distinctly to faintly maculate in the peripheral region, becoming scabrid in central region, and often reticulately cracked in older parts; thallus densely isidiate; isidia filiform, simple to branched, brown black tipped; lowerside pale brown, rarely brown black in the central part with simple, uniformly distributed rhizinae, a narrow (3-5 mm wide) marginal zone light brown or tan and shining; medulla white or sometimes light ochraceous. Apothecia absent in specimens examined.

Thallus K+ yellowish; medulla K+ yellow turning red to red purple, C—, P+ orange; atranorin and salacinic acid+ [protolichesterenic acid has been mentioned by HALE (1965) and norlobaridone (in type specimen) by WINNEM (1975)].

Parmelia subtinctoria is distinctive in the ciliate margin and K+ red reaction in medulla. In these characters it is close to *P. subcrinita* Nyl. (a taxon not yet recorded from India), but can be distinguished by the maculate upper surface. The medulla in *P. subtinctoria* is normally white but in some cases where it is coloured, the colour is apparently due to the decomposition of the salacinic acid. The colour change of medulla is a common occurrence in other *Parmelias* where salacinic acid is present, similar situation has also been mentioned by KUROKAWA (1963) in case of some species of *Anaptychia*. *Parmelia subtinctoria* is widely distributed in pantropical regions and extends to temperate regions.

Specimens examined:

Arunachal—(N.E.F.A.)—Nara to Heyuliang, alt. 450 m, on tree, ROLLA RAO 10738 (AWAS). Himachal Pradesh—Kulu by road side, HÖEG 1463 (AWAS)—densely isidiate, medulla croceous; Manali, alt. 1800 m, on *Cedrus deodara* trunk, HÖEG 1503 (AWAS); AWASTHI & DANGE 75.020 A (LWU); AWASTHI *et al.* (LWU); Parbati river valley, Manikaran to Pulga, alt. 1900 m, on tree trunk, AWASTHI & DANGE 75.083 (LWU). Tamil Nadu—Nilgiri hills; Kilkotagiri to Konada, alt. 1800 m, on rocks, AWASTHI & SINGH 71.12 (LWU); Kotagiri to Kodanad, near Finger Post, alt. 1980 m, on tree trunk, SINGH 71.938 (LWU); Mettupalayam road from Coonoor, in Adderly Shola, SINGH 71.841, 71.854 (LWU); Ootacamund Botanic Garden, alt. 2100 m, on bark, AWASTHI 4451 (AWAS)—det. HALE, 1965; AWASTHI & SINGH 71.280 (LWU)—densely isidiate, isidia branched coralloid; Sholurmatta near Kilkotagiri, alt. 1650 m, SINGH 71.890 (LWU); Palni hills, Kodaikanal, Croaker's Walk, alt. 2100 m, on rocks, AWASTHI & SINGH 69.9 (LWU); Pillar Rocks, alt. 2250 m, on conifer tree trunk, AWASTHI & SINGH 70.266 (LWU); Oothu area, alt. 1250 m, on *Artocarpus integrifolia* tree trunk, AWASTHI & SINGH 70.368, 70.382 (LWU); Shembaganur, S. H. College compound, alt. 1800 m, on tree trunk, AWASTHI 4262 (AWAS)—det. Hale, 1965. Uttar Pradesh—Almora district, on way from Kapkote to Loharkhet, alt. 800 m, on *Albizia* tree trunk, AWASTHI 7506 B (AWAS); Kasardevi, alt. 1800 m, AWASTHI 2449 (AWAS)—det. Hale, 1963; Ranikhet to Chaubattia, alt. 1800 m, AWASTHI 3555 (AWAS); Dehradun district, Mussoorie, alt. 1800 m, on tree trunk, AWASTHI 3816 (AWAS); Askote, near Village Naret, AWASTHI 6423 (AWAS).

32. *Parmelia tinctorum* Nyl.

Flora, 55: 547, 1872; *Zahlbr. Cat. Lich. Univ.* 6: 268, 1930; Hale, *Contr. U.S. Nat. Herb.* 36: 264, 1965. *Parmotrema tinctorum* (Nyl.) Hale, *Phytologia*, 28: 339, 1974.

Plate 9, Figs. 1 & 2

Thallus corticolous or saxicolous, foliose, loosely attached to substratum, 8-20 (largest seen 25×22) cm in diameter, glaucous grey, greyish white to grey, sometimes turning brownish black in the central part and breaking up in pieces; lobes rotund, 10-20 (30) mm wide, somewhat longitudinally folded in marginal region; margin entire, eciliate; upper surface smooth, dull, plane, emaculate, isidiate; isidia mostly laminal in the central part of thallus, rarely marginal, granular to filiform or becoming coralloid branched and rarely

somewhat flattened microphylline, generally up to 1.5 mm long and up to 0.3 mm thick at base, younger isidia often with a brown black punctate dot at the tip; lower side minutely wrinkled and rough, black, sparsely rhizinate in the central part, marginal about 10 mm wide zone erhizinate, reddish brown to dark tan and shining; rhizinae short thick, occurring in groups in central part. Apothecia rare, stipitate, up to 10 mm in diameter, imperforate; disc dark brown, smooth; amphithecium rugose and densely isidiate; hymenium 70-80 μ m high; asci 8 spored; spores colourless, simple, oval ellipsoid (13) 15-18 \times 6-9 μ m; episporium 1.5 μ m thick.

Thallus K+ yellow; medulla K—, C+ red, KC+ red, P—; atranorin and lecanoric acid present.

Parmelia tinctorum is distinctive in its large lobed isidiate thallus, a broad erhizinate shining zone along margin on lower side and medulla C+ red instantaneously. The C+ reaction on medulla is often therefore used to test the effectiveness of C solution before applying it to other lichens. The isidia are mostly granular to filiform, but variations to coralloid branches and in extreme case becoming flattened microphylline also occurs and is probably an ecological modification in warm moist conditions; it does seem to be of taxonomic importance. Between the saxicolous and corticolous plants the former more generally possess granular isidia. The taxon is widely distributed in India and in pantropical regions throughout the world.

Specimens examined:

Unless stated otherwise specimens are sterile.

Assam—No precise locality, 1874, JENKINS (BM); leg ?, No. 306 (BM); Gauhati, near Kamakhya temple, on tree trunk, AWASTHI 8043 (AWAS). Bihar—Chhota Nagpur, Ligirda, on wooden logs, AWASTHI 33 (AWAS). Madhya Pradesh—Hoshangabad district, Pachmarhi, on bark of trees, SINGH 73.71, 73.120, 73.125 (AWAS). Maharashtra—Panchagani, on rocks, AWASTHI 4055 (AWAS)—det. Hale, 1965. Meghalaya—Khasi hills, Kellong, alt. 1500 m, HOOKER & THOMSON 1957 (BM)—pr. p. + *Parmelia reticulata*; Nunklow, HOOKER & THOMSON 1986 (BM)—pr. p. + *P. austrosinensis*; Shillong, on bark, BHATT 3387 (AWAS); SUBRAMANIAM 4033 (AWAS); Sillong peak, alt. 1950 m, on tree trunk, AWASTHI 6468 (AWAS); Elephant Falls, on Pine tree trunk, AWASTHI 7897 (AWAS); on route to Jowai, on Pine tree trunk, AWASTHI 8007 (AWAS); near Thadlaskein Lake, alt. ca. 1800 m, AWASTHI 8023, 8066 (AWAS). Sikkim—No precise loc., alt. 2100 m, —HOOKER 1955, 2006 (BM); Chongtem, alt. 1800 m, HOOKER 2002 (BM)—pr. p. + *P. nilgherensis*; Jongri, BOSE 60.125 (AWAS); Gangtok alt. 1650 m, AWASTHI 31 (AWAS). Tamil Nadu—Madras, no precise loc. HOOKER & THOMSON (BM)—largest thallus (25 \times 22 cm) seen amongst herbarium specimens (Plate 9, Fig. 1); HOOKER & THOMSON 1956 (BM); Nilgiri hills; Coonoor, alt. 1680 m, on tree trunk, AWASTHI & SINGH 70.1338, 70.1389 (LWU); 2 miles towards Mettupalayam from Coonoor, on rock, SINGH 71.825 (LWU); Avalanche near Power House, SINGH 71.763 (LWU); Kilkotagiri to Kodanad, on tree, AWASTHI & SINGH 71.10 (LWU); near Kodanad tea estate, alt. 2010 m, on tree trunks, AWASTHI & SINGH 70.1410, 70.1502, 71.65 (LWU)—variation from granular filiform to coralloid and microphylline isidia in the same thallus; Kotagiri to Kodanad, alt. 1880 m; on tree trunk, SINGH 71.931 (LWU); Sholurmatta near Kilkotagiri, alt. 1650 m, on tree trunk, SINGH 71.904, 73.730 (LWU); Palni hills; Kodaikanal, near Pillar rocks, alt. 2250 m, on Rhododendron tree trunk, AWASTHI & SINGH 70.222, SINGH 70.696 (LWU); Golf Club area, on tree, SINGH 70.638 (LWU); near Lake, on tree 70.783, 70.1037 (LWU); Oothu area, alt. 1200 m, AWASTHI & SINGH 70.355, SINGH 70.1242 (LWU). Pannai Kodu, on bark, FOREAU 4107 A (AWAS); Perumal Coffee plantation, on tree trunk, AWASTHI 4350, (AWAS); SINGH 70.1107 (LWU); Perumal to Palni road, SINGH 70.945 (LWU); Shembaganur alt. 1800 m, FOREAU 4090 A, 4174 (AWAS)—det. Hale; Shembaganur, S. H. College, on *Pyrus* tree, AWASTHI & SINGH 70.65 (LWU); SINGH 70.862, 70.895 (LWU)—isidia microphylline; Silver Cascade, AWASTHI & SINGH 70.161 (LWU); Sirudamkanal Shola, 1750 m, on tree, FOREAU 4549 (AWAS)—det. HALE. Uttar Pradesh—Almora district, Almora, PANT 435 (AWAS); Jageshwar hill, alt. 2050 m, AWASTHI 3511 (AWAS)—fertile; Kapkote to Loharkhet, alt. 1200 m, on rocks, AWASTHI 7519 (AWAS), Kasardevi, on Pine tree trunk, SEN 3172 (AWAS); Ranikhet Chaubattia, alt. 1800 m, AWASTHI 3556 (AWAS); SESHADRI 3610 (AWAS); AWASTHI & DANGE 74.80, 74.100 (LWU); Dehradun district, comm. SESHADRI 3394 (AWAS); Pithoragarh district, Chandak on *Cedrus* tree trunk, AWASTHI (AWAS); Askote, Dhanlek, alt. 1800 m, on rocks, AWASTHI 2707 (AWAS)—fertile; on rocks and bark, AWASTHI 3953, 3952 (AWAS); Chinar, alt. 2610 m, STRACHEY & WINTERBOTTOM

(BM)—pr. p. + *Parmelia wallichiana*. West Bengal—Darjeeling district, Darjeeling, alt. 2000—2250 m, on trees and rocks, AWASTHI 3103, 3838, 3874 (AWAS); BOSE 60.189 (AWAS); Kalimpong, BOSE 60.45 (AWAS); alt. 1500 m, AWASTHI & AGARWAL 67.233 (LWU)—pr. p. + *P. wallichiana*, AWASTHI & AGARWAL 67.263, 67.285, 67.315 A (LWU)—faintly isidiate; Kurseong alt. 1650 m, AWASTHI 3922 (AWAS); Dow Hill, AWASTHI & AGARWAL 66.218 (LWU); Manabari tea estate, alt. 300 m, on *Albizia* tree trunk, AWASTHI & AGARWAL 66.49 (LWU); above Sukna, alt. 500 m, on tree trunk, AWASTHI & AGARWAL 66.90 (LWU); Tonglloo, alt. 3000 m, HOOKER 1998 (BM)—pr. p. + *P. wallichiana*.

Extra-Indian specimens examined:

E. Nepal—Tamber valley, alt. 1200 m, HOOKER 2088 (BM); Phenikhola valley, below Phidim, on *Shorea robusta* bark, alt. 850 m, AWASTHI 2176 (AWAS).

33. *Parmelia ulophyllodes* (Vain.) Sav.

In L. Sav. *Bull. Jard. Imp. Bot. Pierre le Grand*. 15: 316, 1915.

Parmelia dubia var. *ulophyllodes* Vain. *Acta Soc. Faun. Fl. Fenn.* 13(6): 7, 1896.

Parmelia borrieri var. *ulophyllodes* (Vain.) Zahlbr. *Cat. Lich. Univ.* 6: 157, 1930..

Plate 10, Fig. 2

Thallus corticolous, foliose, closely adnate to agglutinated to substratum, 6-8 cm in diameter, thick coriaceous, yellowish green to yellowish grey or grey; lobes close to compact, 3-5 mm wide, ascending, imbricate to confluent, margin entire to crenate, eciliate; upper surface smooth to lacunose-rugulose or wrinkled longitudinally; isidia, soredia and pseudocyphellae absent; lower side black, closely adnate to agglutinated to substratum by hyphae, sparsely rhizinate in the greater central part, a narrow marginal zone erhizinate, dark tan and smooth shining or lobes agglutinated to substratum up to the margin; thallus sorediate, soralia marginal, crescent shaped, sinuous, \pm revolute, sometimes globose sub-marginal; medulla white. Apothecia very rare, up to 3 mm in diameter, constricted at base, imperforate, disc brown, amphithecium marginally sorediate; hymenium 60-70 μ m high; asci 8 spored; spores colourless, simple, oval, $13-17 \times 7-8.5 \mu$ m.

Thallus K—; medulla K—, C+ red, KC+red, P—; usnic and gyrophoric acid present.

Parmelia ulophyllodes closely resembles *P. flaventior*, the two often growing together. Chemically they are similar, the distinction between the two being the presence of pseudocyphellae in *P. flaventior*, and their absence in *P. ulophyllodes*. In addition the thallus of *P. ulophyllodes* has narrower lobes, is generally agglutinated to substratum by greater area. The taxon is distributed in temperate regions of northern hemisphere.

Specimens examined:

Himachal Pradesh; Kulu, by road side, on bark, HÖEG 1464 B (AWAS)—det. HALE; Chhika alt. 2850 m, on bark HÖEG 1771 (AWAS)—det. HALE; pr. p. *P. flaventior*; Manali, alt. 1800 m, HÖEG 1767 (AWAS); Parbati river valley, Pulga, alt. 2340 m, on conifer trees, AWASTHI & DANGE 75.169 B, 75.176, 75.289 (LWU), 75.178 pr. p. + *P. flaventior*, (LWU)—fertile.

Extra-Indian specimens examined:

Pakistan—Thandiani, McVEAN 60.8, 60.75 (AWAS).

34. *Parmelia xanthina* (Müll. Arg.) Vain.

Acta Soc. Faun. Fl. Fenn. 7, no. 7: 37, 1890; Zahlbr. *Cat. Lich. Univ.* 6: 271, 1930; Hale, *Contr. U. S. Nat. Herb.* 36: 275, 1965.

Parmelia proboscidea Tayl. var. *xanthina* Müll. *Arg. Flora*, 67: 616, 1884.

No specimen has been found to conform to this taxon in our collection, but since HALE (1965, p. 277) has recorded the species to occur in Nilgiris, Coonoor, based on

specimen collected by GRAY (preserved at P), the following description is being given for ready reference on the basis of HALE's (l. c.) publication.

Thallus saxicolous or corticolous, loosely attached to substratum, 8-20 cm in diameter, yellowish green, lobes 8-12 mm wide, margin isidiate, dissected and ciliate; upper surface plane, dull, reticulately cracked with age, isidia marginal to submarginal, simple to coral-loid and often apically ciliate; lower side rhizinate in central part, black, marginally erhizinate, dark brown and shining; medulla white. Apothecia absent.

Thallus K+ deep yellow; medulla K—, C—, KC+ red, P—; atranorin, protoliches-terenic and usnic acids present.

35. *Parmelia yodae* Kurok.

J. College Arts Sci. Chiba, 5(1): 97, 1967. Type, East Nepal, Rolwaling Himal, Sikra, alt. 2300 m, Yoda 53 a (TNS), not seen.

The taxon described from East Nepal has every likelihood to be occurring in the eastern Himalayas, particularly in Darjeeling district, and the description is therefore being given below based on KUROKAWA (l. c.). No specimen in our collection has been found to conform to this description.

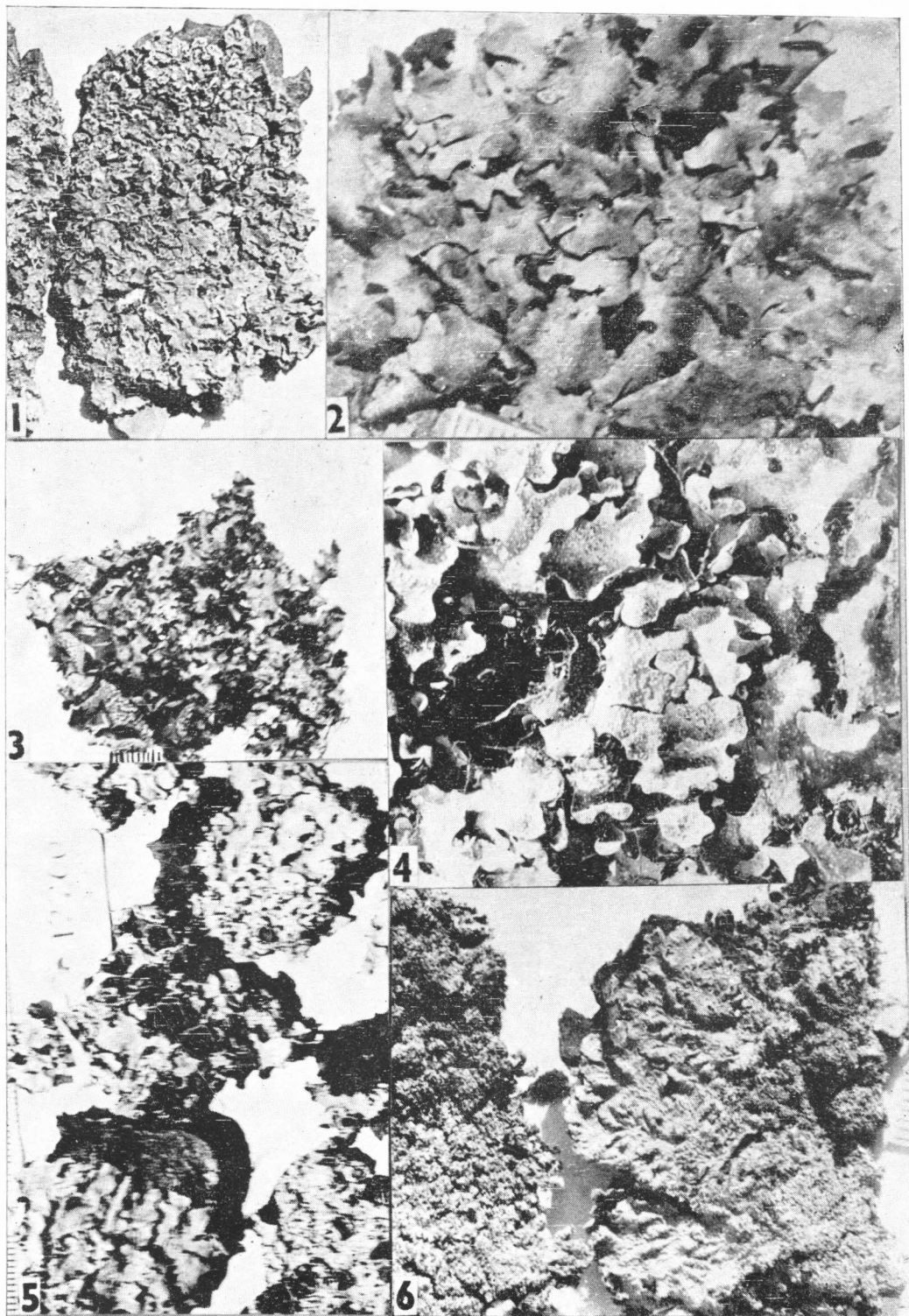
Thallus 3-5 cm in diam., grey white, irregularly lobed, lobes 4-10 mm wide, emaculate, margin \pm undulate, sparsely ciliate, cilia simple to rarely branched, 1-1.5 mm long; soralia marginal or submarginal; lowerside dark brown to black, rhizinate, rhizinae dimorphic. Apothecia not present.

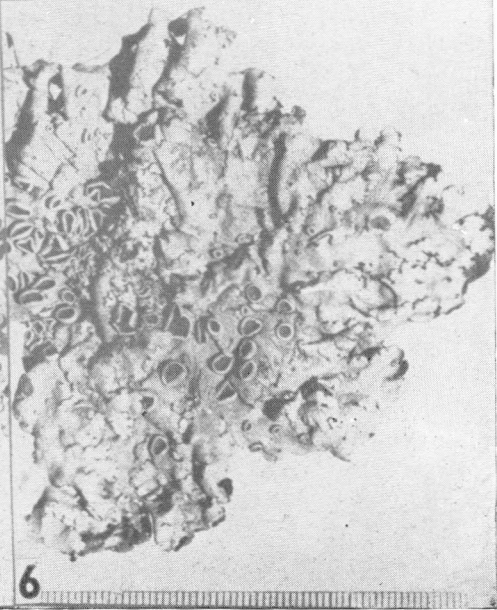
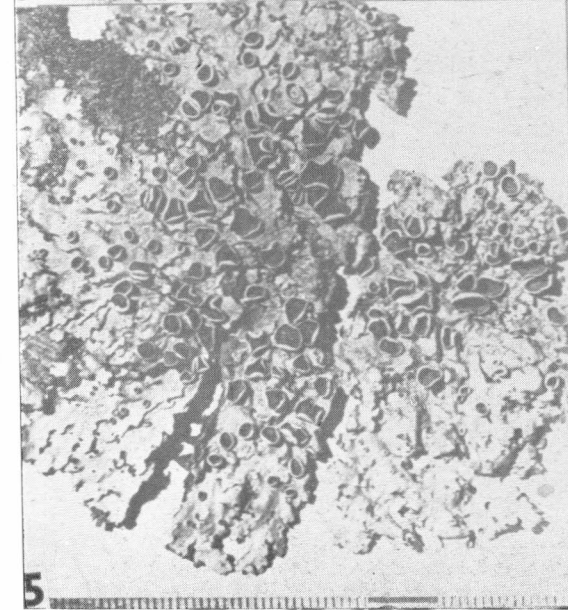
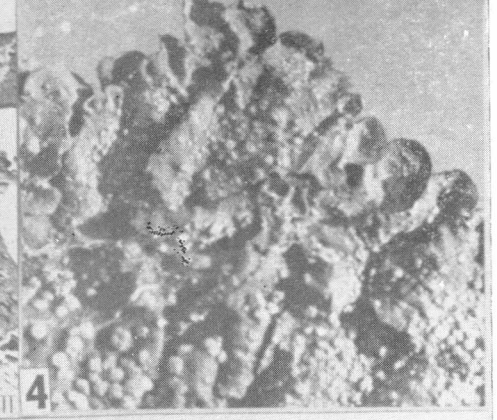
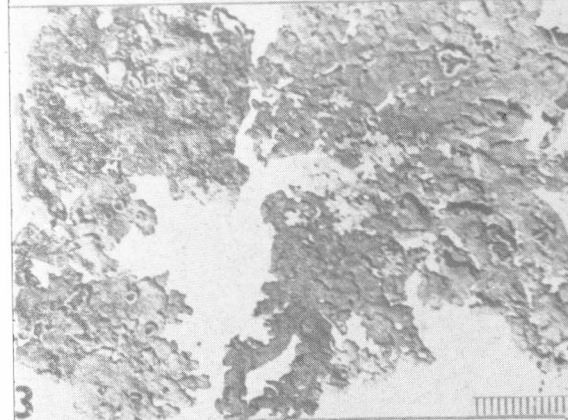
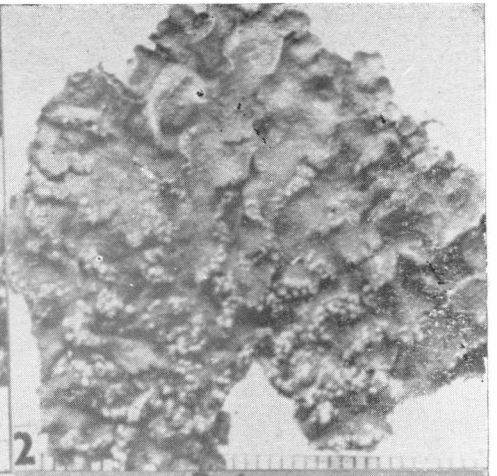
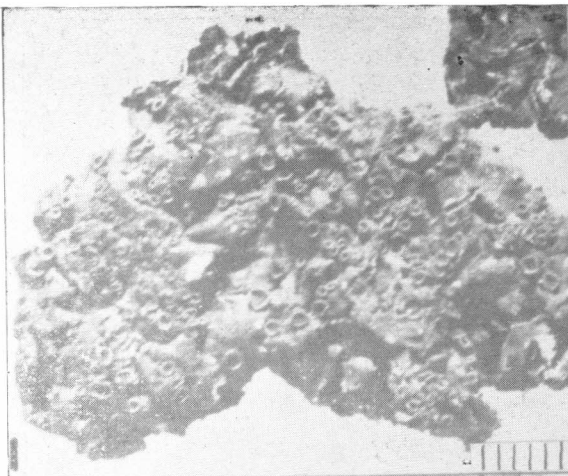
Thallus K+ yellow; medulla K—, C—, KC+ reddish P—; atranorin and loxodic acid present.

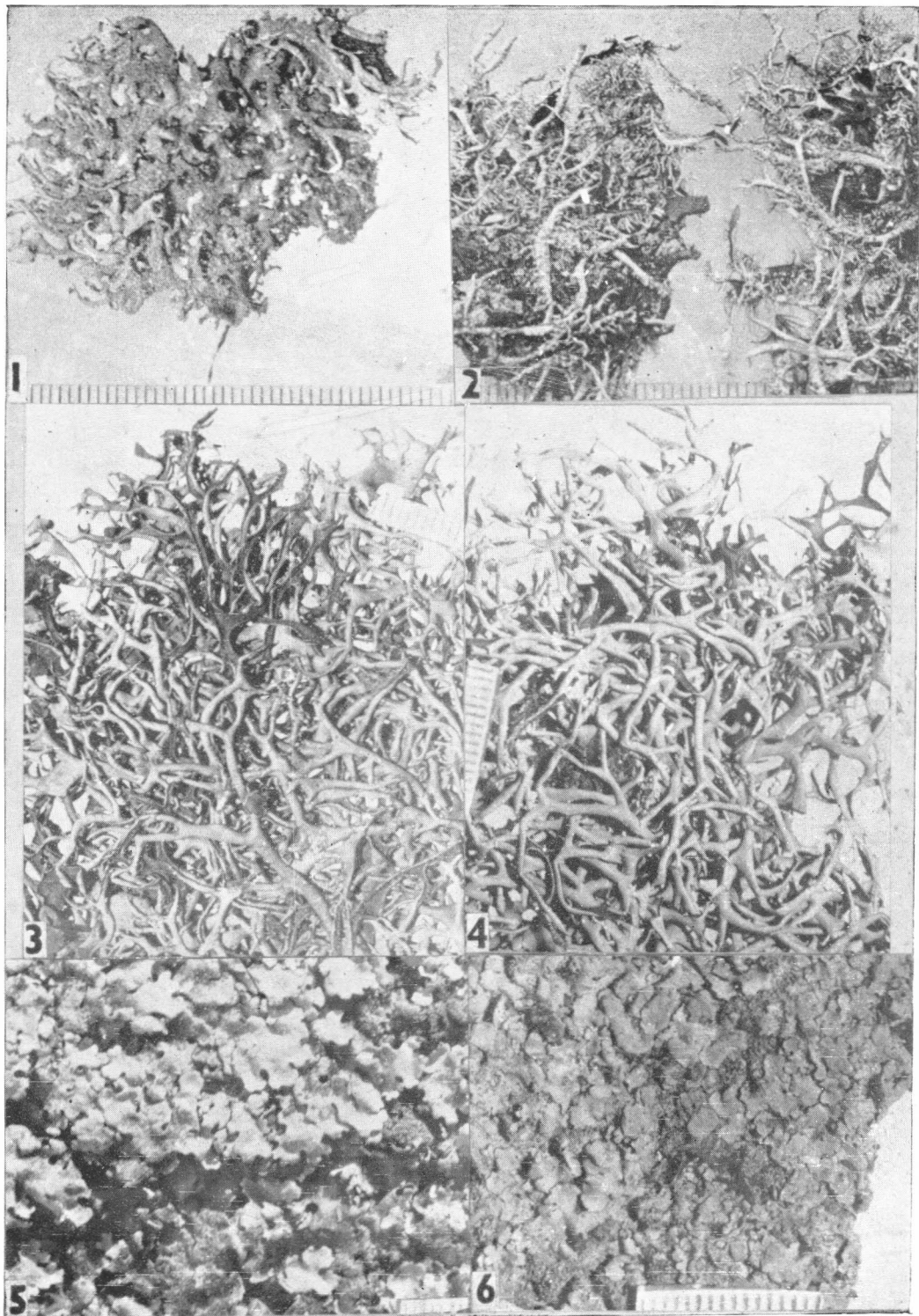
It "resembles *Parmelia subsumpta* Nyl. in having marginal soredia, cilia, brown to blackish brown under surface and dimorphous rhizines. However, it is easily distinguished from *P. subsumpta* by the absence of maculae on the upper surface, negative colour reaction with P, and presence of loxodic acid rather than salacinic acid" (KUROKAWA, l. c.).

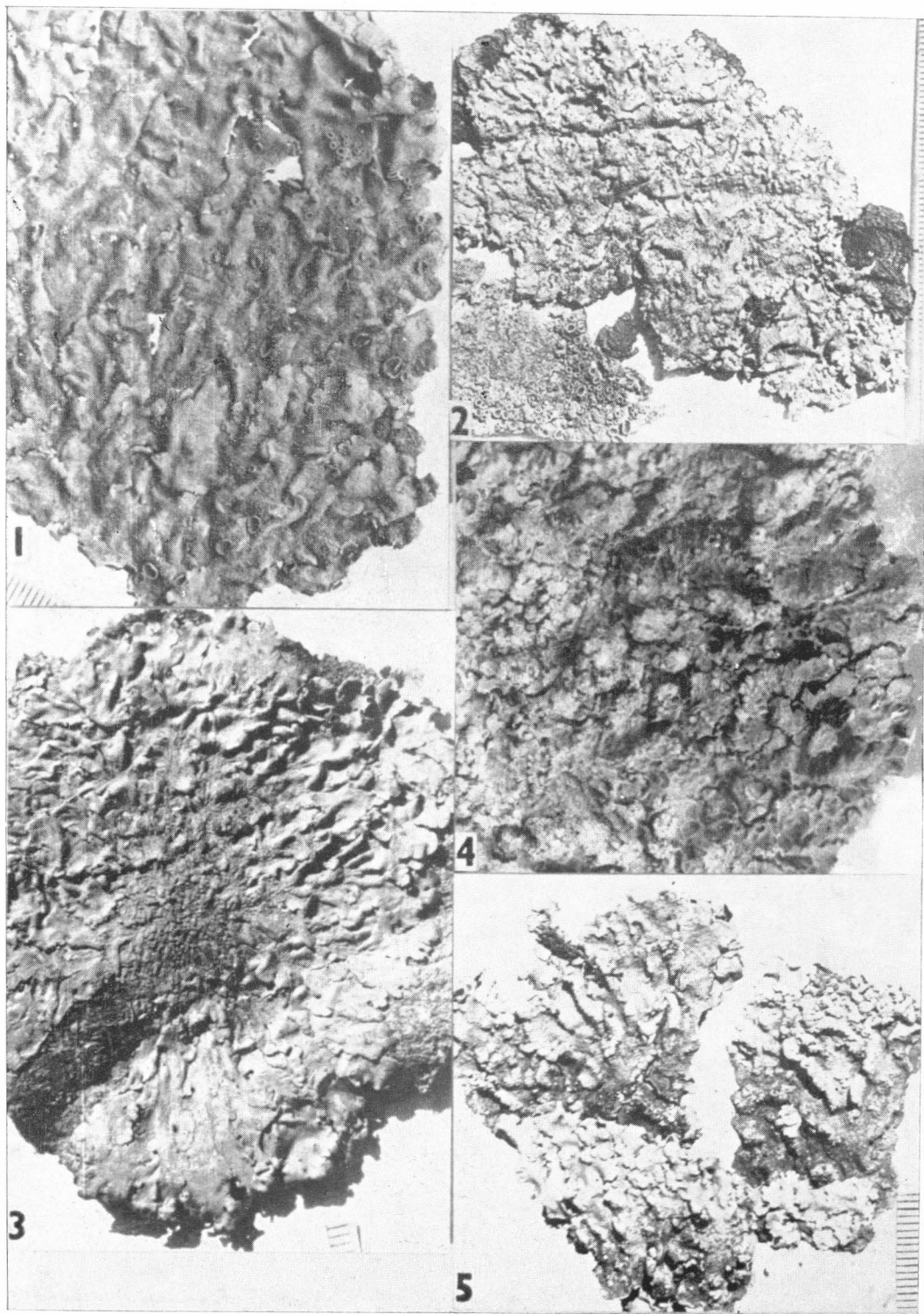
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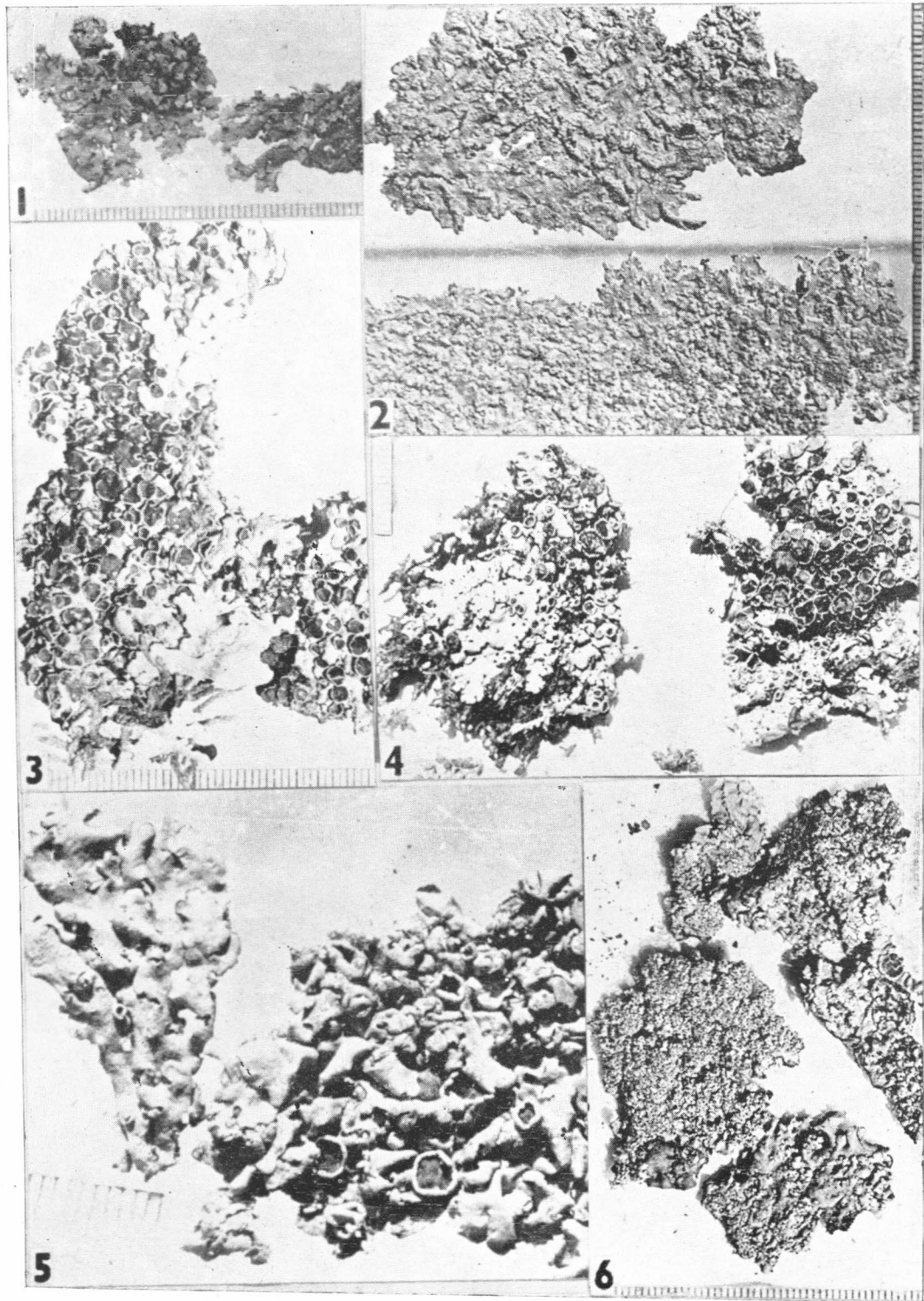
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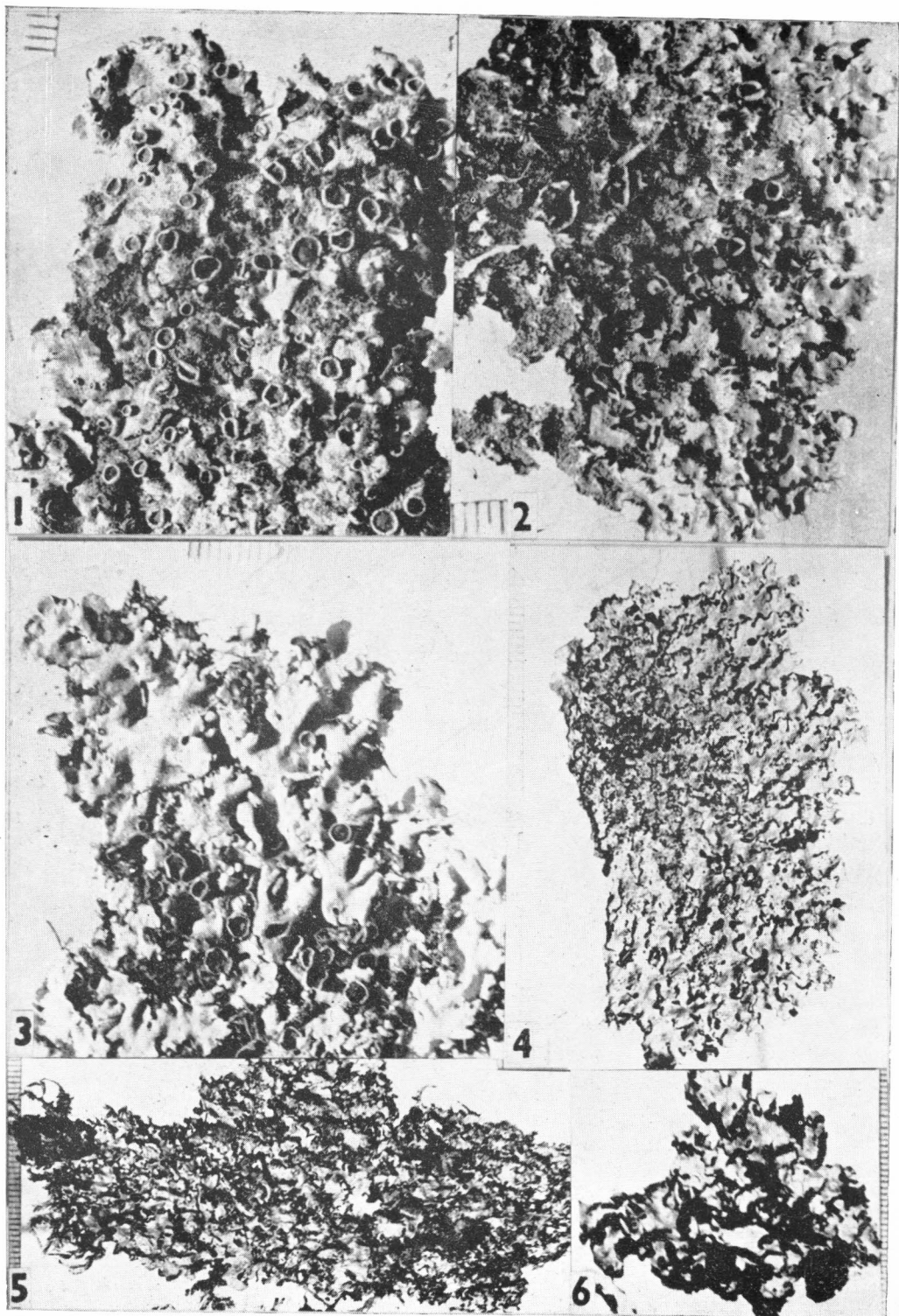


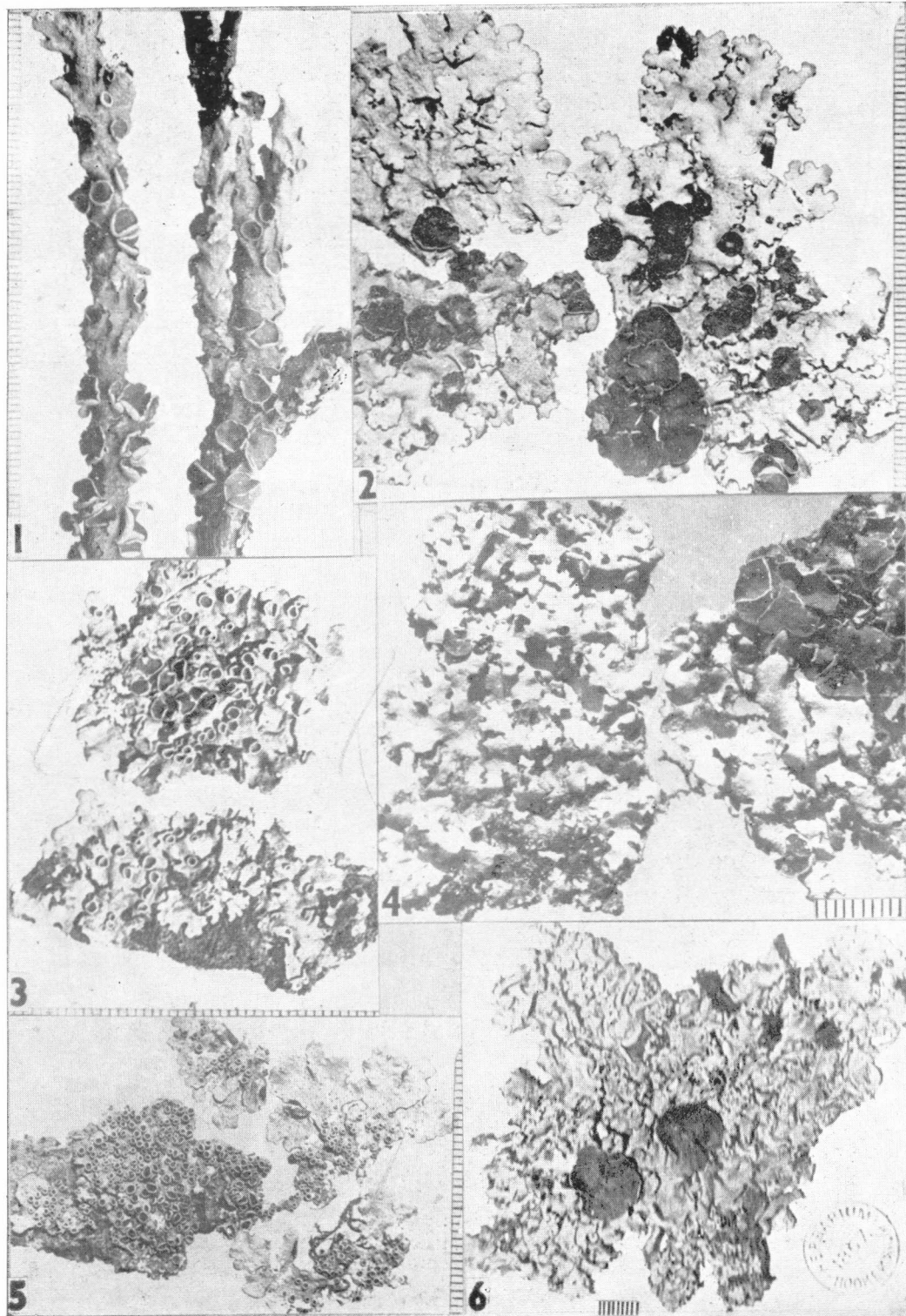


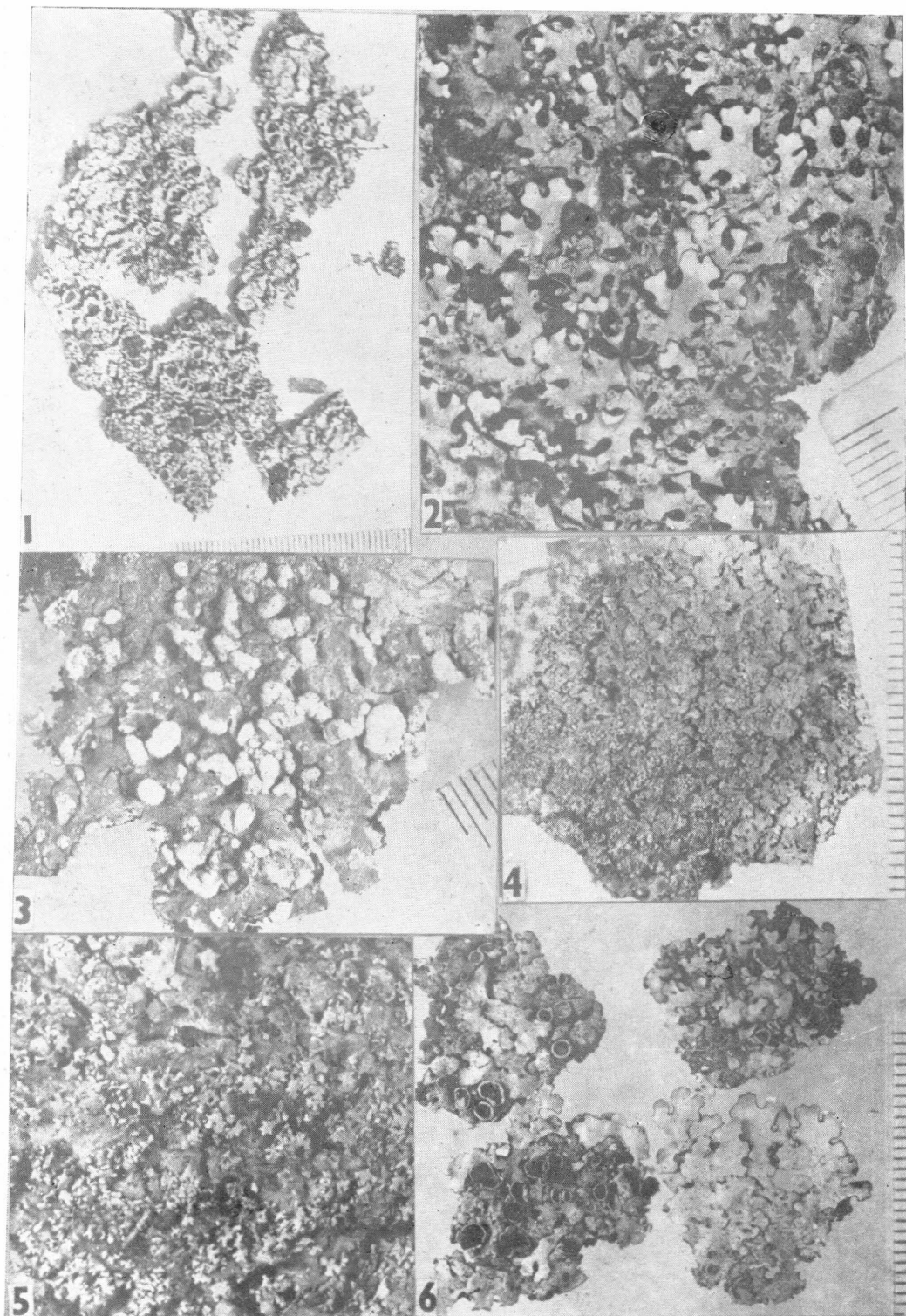


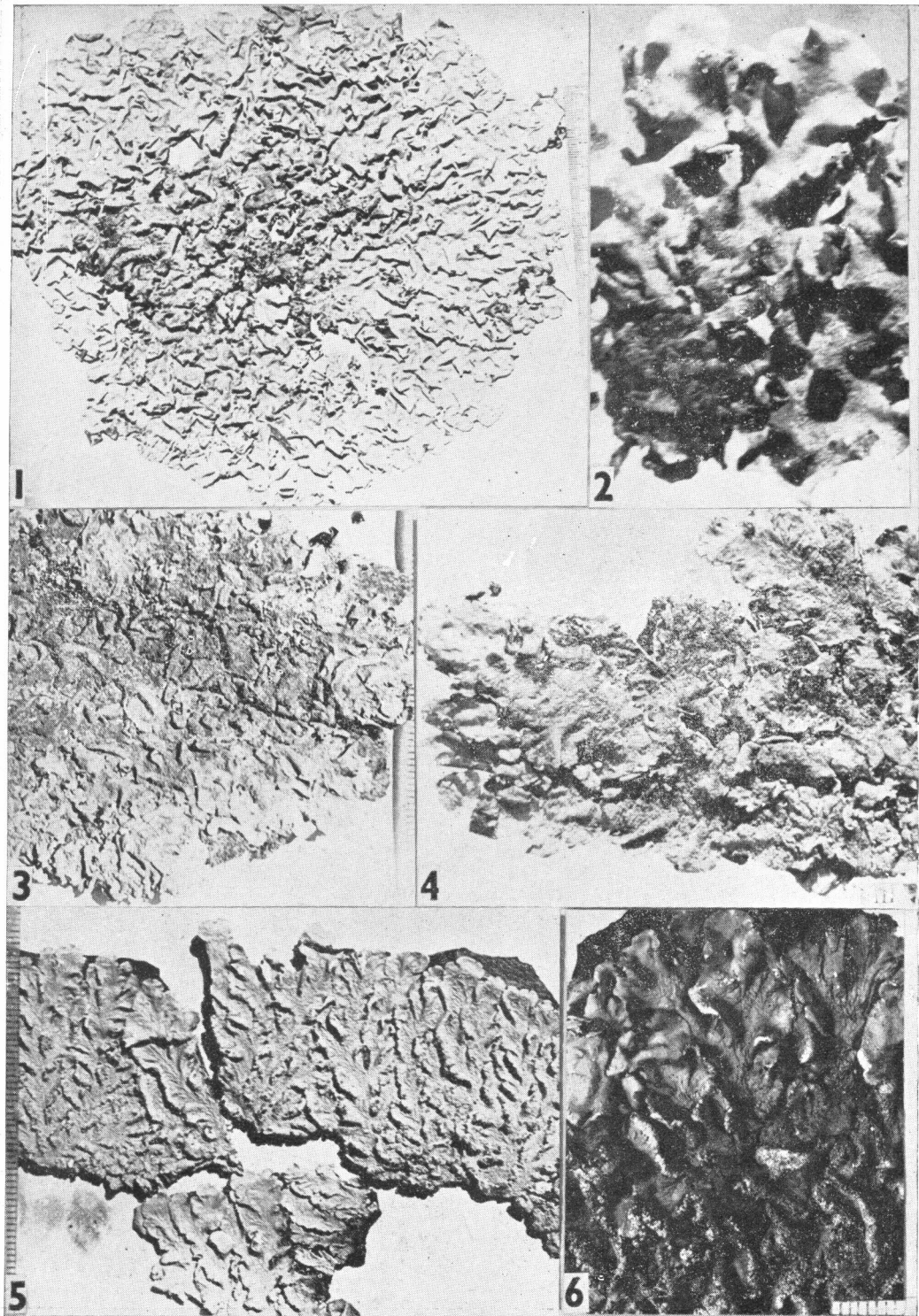


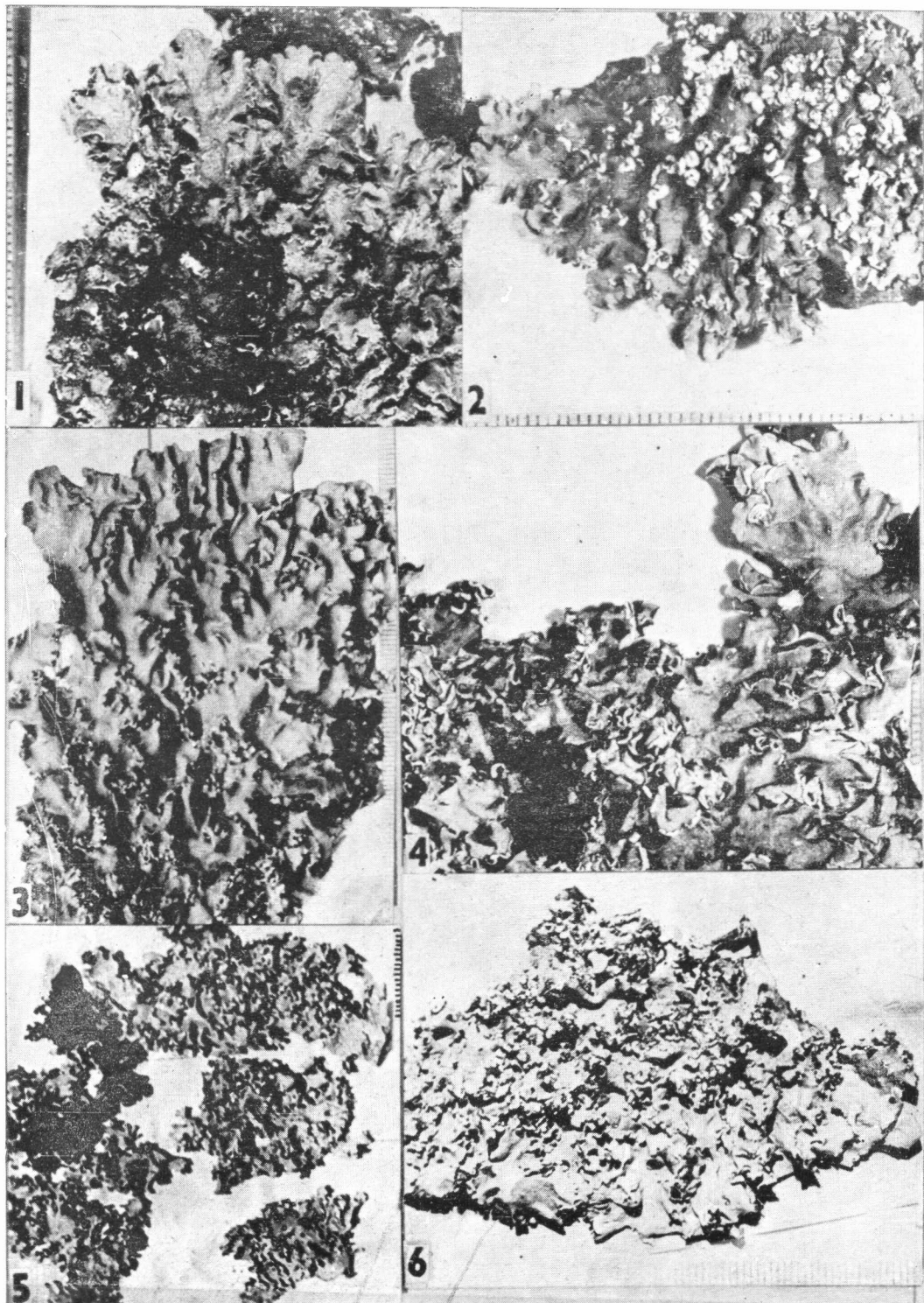


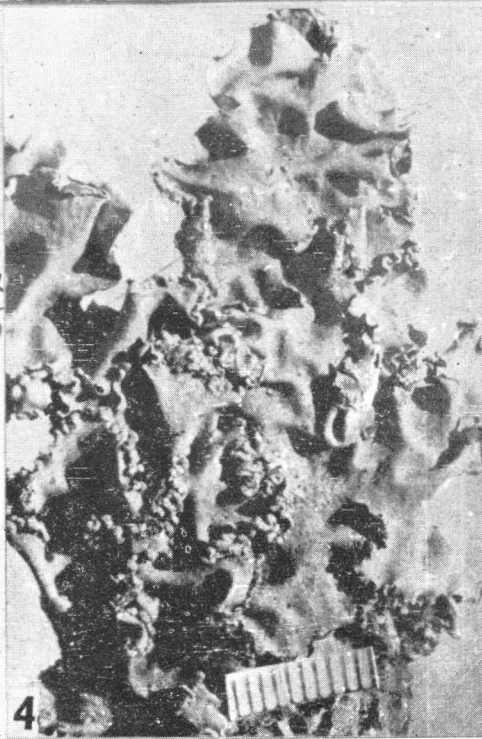
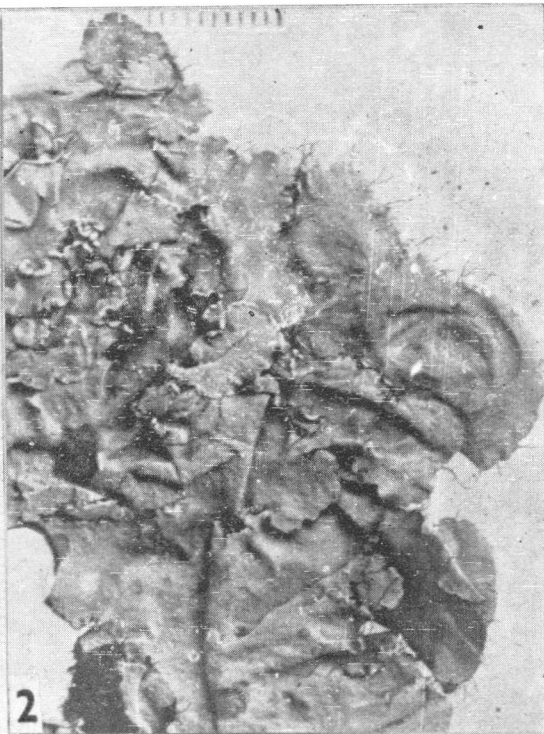
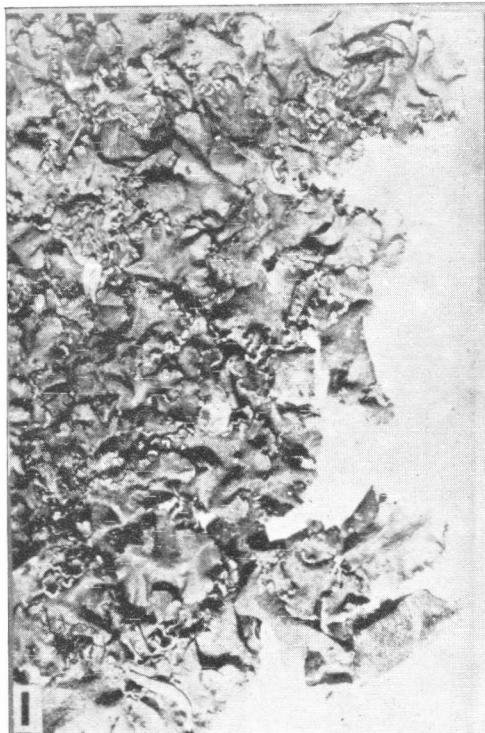


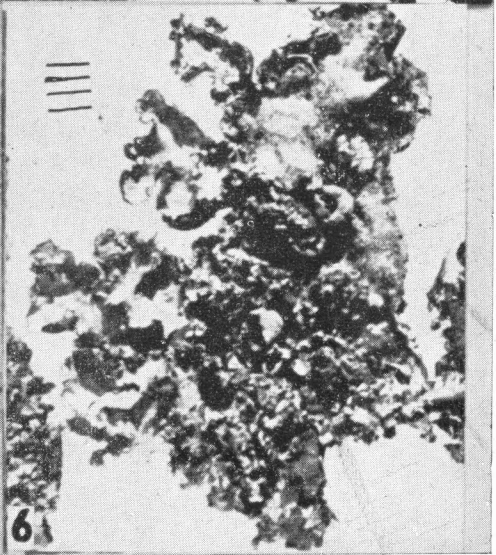
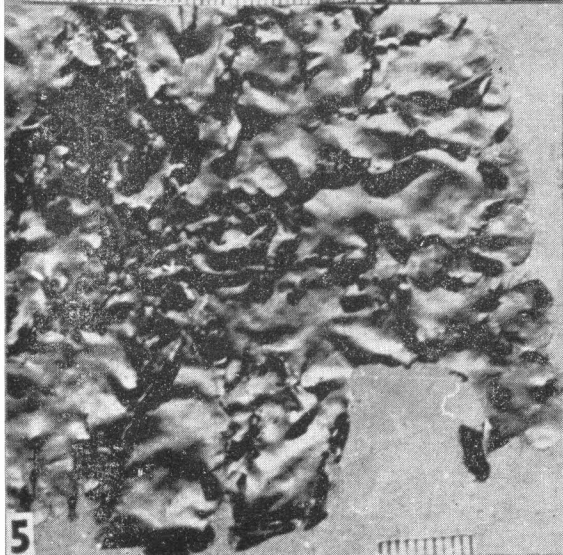
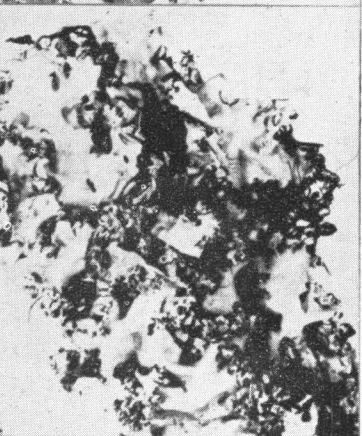
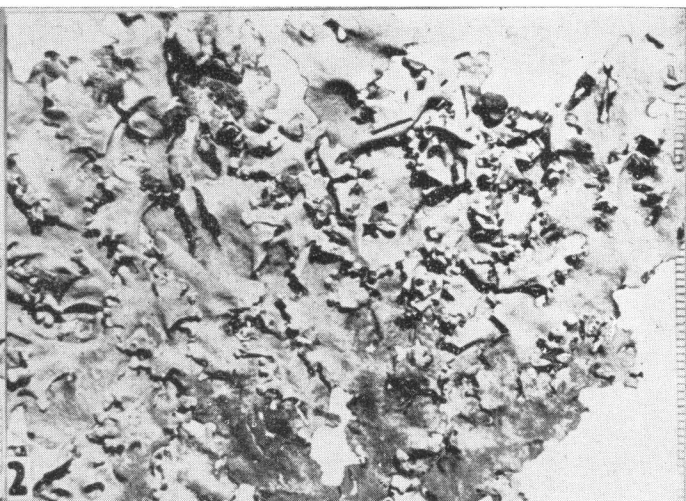
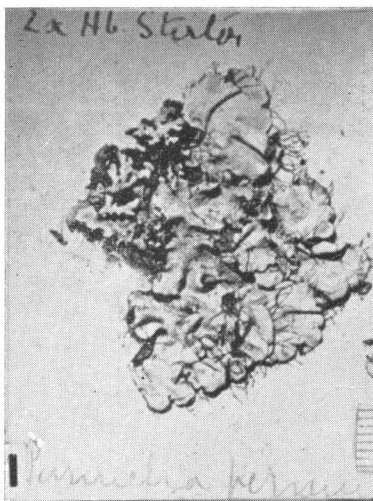


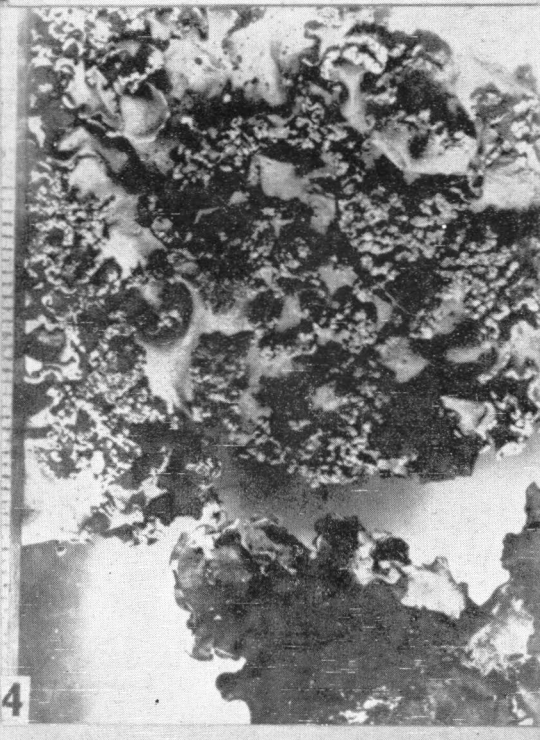
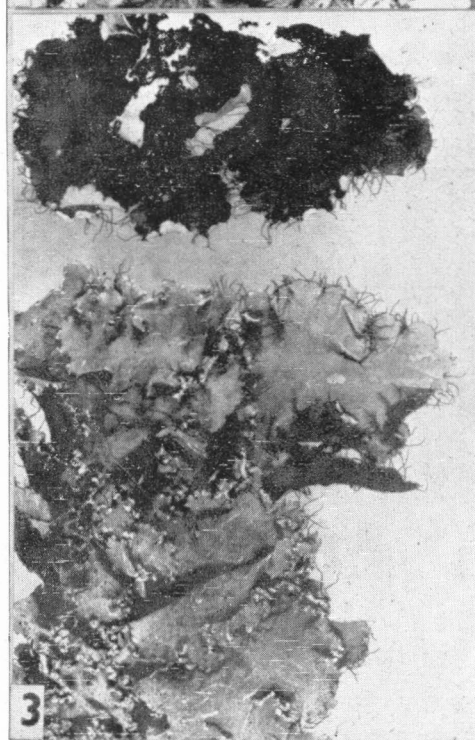


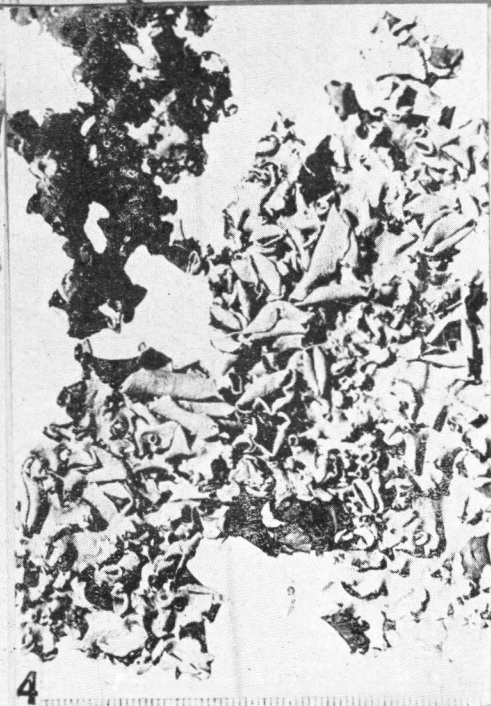
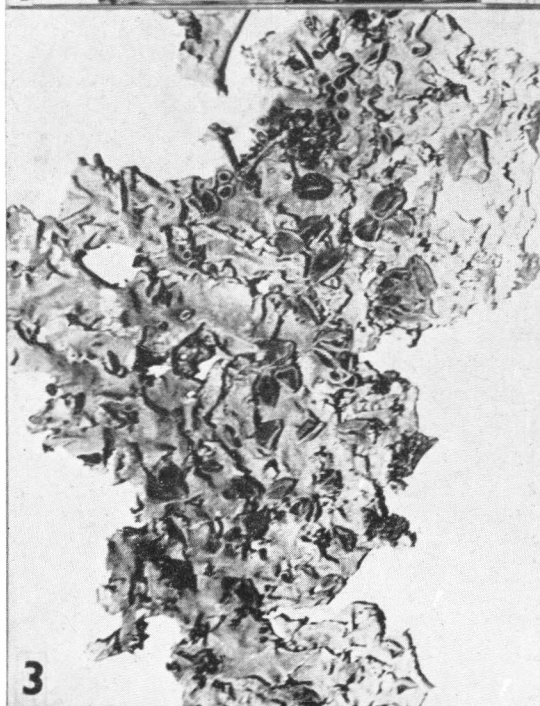


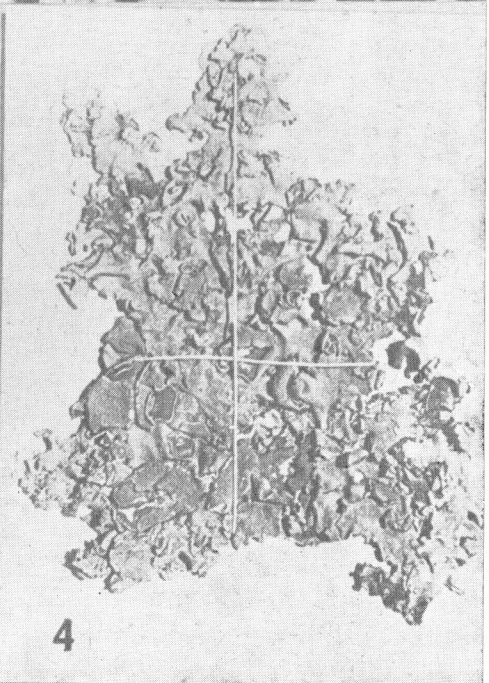
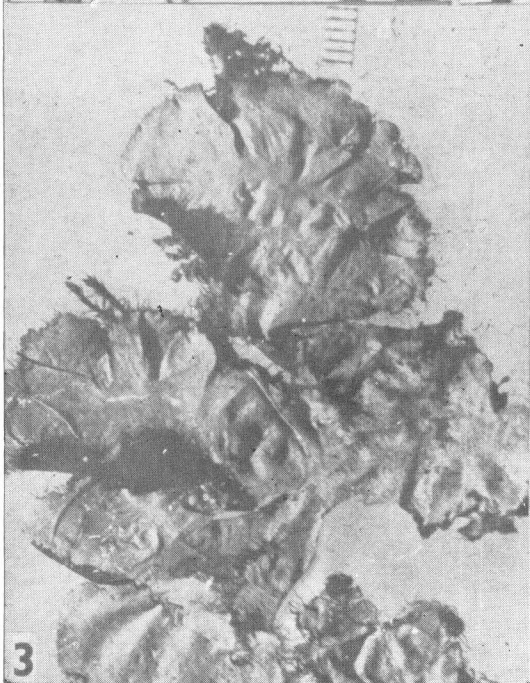
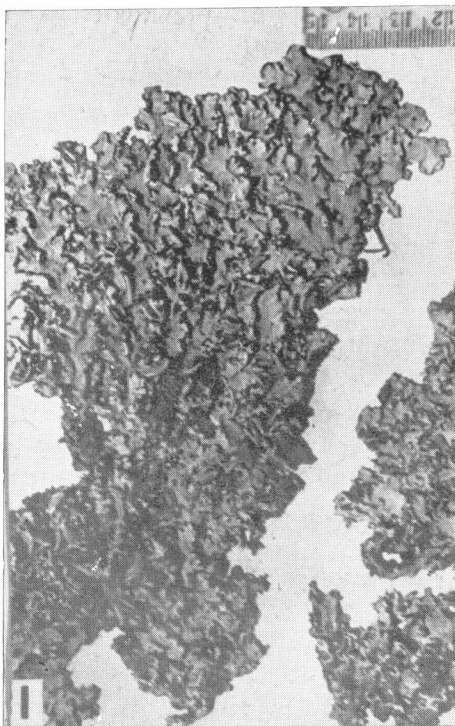












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EXPLANATION OF PLATES

(Each division of the scale = 1 mm)

- Plate 1—Figs. 1-6: 1. *Parmelia sulcata* Tayl.; 2. *Parmelia meiophora* Nyl.; 3. *Parmelia pseudomarmariza* Awas. (Holotype); 4. *Parmelia pseudomarmariza* Awas.; 5. *Parmelia submutata* Hue; 6. *Parmelia rudecta* Ach.
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